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Seeds in a globalised world: agricultural biotechnology in Zimbabwe

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Summary

Great claims are made both for and against the potential contribution of GMOs to the future of African agriculture. This paper explores this, looking at what biotechnology might mean for agricultural and food production systems in Zimbabwe. It focuses on two key crops, cotton and maize, and argues that choices about possible biotechnology futures have to be understood in relation to trends towards globalisation and liberalisation of the seed industry, and also shifts in the political economy of agriculture, both at home and overseas. Assuming that there is support for some role for agricultural biotechnology in Zimbabwe, and leaving aside questions of regulation, several key choices emerge, linked to four different future scenarios: is it best to rely on market-supply of technologies from multinational corporations? Or should Zimbabwe seek to develop technologies independently? Alternatively, if the latter is unrealistic, what scope is there for the pursuit of a middle position, striking bargains with big corporations and pushing for more locally appropriate forms of technology? Or, finally, are choices ultimately irrelevant with the most likely outcome being that transgenic biotechnology essentially passes Zimbabwe by? Several factors are identified that are key to these different scenarios, these include: technology choice; issues of technology access and ownership; the – as yet uncertain – role of new farmers emerging as a result of land reform and changes in the agrarian economy; the shifting dynamics of seed markets; changing industrial structure and ownership patterns; new economic conditions and trends in international trade relating to GMOs. The paper concludes that these contexts and trade-offs need to be brought more specifically into debates about alternative GM or non-GM futures in Zimbabwe, and elsewhere in Africa, than has happened to date.

Contents

	Summary	iii
	Preface	vii
	Acknowledgements	viii
1	**Introduction**	**1**
2	**Maize and cotton in Zimbabwe**	**2**
	2.1 Maize	3
	2.2 Cotton	5
3	**Liberalisation and the changing seed industry**	**6**
4	**Choices and contexts for the agriculture and biotechnology policy debate**	**11**
	4.1 Technology choices	11
	4.2 Technology access and ownership	12
	4.3 The new farmers – consequences of changes in the agrarian economy	14
	4.4 Seed markets	15
	4.5 Industry structure and ownership	16
	4.6 Economic conditions	17
	4.7 International trade and GM choices	18
5	**Future scenarios**	**19**
	5.1 Scenario 1	19
	5.2 Scenario 2	20
	5.3 Scenario 3	20
	5.4 Scenario 4	21
	References	**23**

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Preface

Biotechnology Policy Series

This IDS Working Paper series emerges from a series of three interlinked projects. They involve collaboration between IDS and the Foundation for International Environmental Law and Development (FIELD) in the UK and partners in China (Center for Chinese Agricultural Policy (CCAP)), India (Centre for the Study of Developing Societies, Delhi; Research and Information Systems for the Non-Aligned and Other Developing Countries (RIS), Delhi; National Law School, Bangalore), Kenya (African Centre for Technology Studies, Nairobi) and Zimbabwe.

Three key questions guide the research programme:

- What influences the dynamics of policy-making in different local and national contexts, and with what implications for the rural poor?
- What role can mechanisms of international governance play in supporting the national efforts of developing countries to address food security concerns?
- How can policy processes become more inclusive and responsive to poor people's perspectives? What methods, processes and procedures are required to "democratise" biotechnology?

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1 Introduction

This paper examines the challenges posed by new agricultural biotechnologies for crop research and the seed industry in Zimbabwe, and more broadly in the region. We focus on two crops – maize and cotton. Both are widely grown in both the small and large-scale agricultural sectors, and contribute significantly to national food and income security and foreign exchange earning potentials through exports of cotton products and maize seed.

New agricultural biotechnologies – particularly transgenic products – are seen by some as revolutionising the seed industry and the agricultural and food production system as a whole. For the advocates, such technologies offer the potentials of reducing costs of inputs and decreasing the environmental damage of chemical dependent agriculture (cf. Wambugu 2001; DeVries and Toenniessen 2000; Qaim 1999)[1]. For detractors, such technologies present potential threats to food safety, biodiversity, export markets and more sustainable forms of agriculture more appropriate to smallholder farmers (cf. Kuyek 2002a,b ; Panos Institute 2002).

How should Zimbabwe position itself in relation to GM crops? As a small country, with limited local capacity for generating its own biotechnologies, independently of international collaboration and arrangements with transnational corporations, it is necessarily bound into a process which is far larger than domestic policy processes and regulatory decision making. Should it go down the GM route, allowing the "free market" and the big corporations to dictate the terms? Should it seek to go it alone, and develop its own local technological capacity independently? Or should it attempt to strike bargains and negotiate a middle ground that, at one time does not deny the reality of a globalised agricultural and food industry, where biotechnology is seen as central to future commercial strategies (at least for some major companies), but, at the same time, safeguards the public interest and the developmental challenges of poverty reduction and food security? Or should it follow a GM-free path?

Seed industry players, consumers, producers, regulators and their representatives must respond to these questions, and urgently. A laissez-faire approach seems not on the cards, although, as the GM food imports debate highlighted during 2002, a move towards a GM option may be the default unless regulators are on their guard. An isolationist, go it alone, approach, despite some strident nationalist rhetoric and anti-GM feeling in some quarters, is also unlikely. But striking a balance is less easy than it might appear. Many variables, unknowns, and multiple interests and actors (some with, some without vocal representation) are implicated, making decisions now, and contexts for policy processes key to future trajectories of agriculture in the country.

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[1] In southern Africa, the main non-government proponent of biotechnology has become AfricaBio (see www.africabio.com), and particularly Jocelyn Webster, who focuses on public engagement and Muffy Koch, who focuses on biosafety training. AfricaBio, together with other well-established pro-biotech organisations based in Kenya – the African Biotechnology Stakeholders Forum and the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), hosted a major conference on biotechnology in Johannesburg in 2001, sponsored by the private sector, USDA and the Rockefeller Foundation, see www.africabio.com/conference. Zimbabwean NGOs, most notably the Biotechnology Trust of Zimbabwe (see BTZ 2001; 2002), have worked closely with AfricaBio, but maintain a more neutral stance.

In 2001 the first field trials for GM crops were approved by the Biosafety Board, the regulatory authority situated in the Zimbabwe Research Council under the President's office. This has of course brought into sharp focus a range of specific scientific and regulatory questions (see Keeley and Scoones 2003). This paper, however, looks at the broader context of R and D strategy, both in the public and private sectors (and increasingly interactions between them), and the wider position of the Zimbabwean cotton and maize industry within the regional economy. The paper is an attempt, then, to spell out some of the strategic questions that lie behind any decisions to go the GM route in agriculture (or more particularly for maize and cotton). In doing so the paper analyses the implications for various actors – industry (both local, and multinational), producers (both large scale and communal), research and development (both public and private, national and international), as well as governmental regulatory authorities. With the changing structure of the agricultural economy following the land reform of the last two years, these challenges have taken on a new complexion, making the strategic challenges suggested here both more complex and more urgent.

The first section of the paper sets the scene by offering a brief historical review of the maize and cotton sectors in the country, outlining the long history of local public sector R and D and how these crops are linked to a broader – and shifting – political economy of agriculture and land ownership in the country. The second section moves to a description of the changing structure of the seed industry, particularly over the last decade or so, and the implications a liberalisation of the sector has had on structures of ownership and control. A series of profiles of key players – both public and private, local and international (and, importantly, gradations between these categories) – is then offered which highlights how different actors view biotechnology, both as a potential and a threat. The implications of this positioning for the framing of debates, and the formation of coalitions, alliances and networks in the policy process are then discussed. The next section in turn examines how different actors view some of the key trade-offs in the policy debate. The paper concludes with some reflections on the possible scenarios for the future of biotech in Zimbabwe and some of the more general lessons learned.

2 Maize and cotton in Zimbabwe

Maize and cotton are perhaps the two key strategic crops in the country, particularly for the smallholder sector. Maize is the staple food for the vast majority of Zimbabweans and cotton is a significant cash crop, especially for smallholders (e.g. Rukuni and Eicher 1994; Mariga 1994; Mashingaidze 1994; Scoones *et al.* 1996; Rusike 1998). Both crops have witnessed major public sector investments in breeding, agronomy, pest control and so on over the last 50 years, with major improvements in yield resulting (Hikwa *et al.* 2000; Lipton and Longhurst 1989). As the former chief agronomist of the Zimbabwe Grain Producers' Association put it 'We have the top maize breeding in Africa. Conventional means have done a fantastic job'. But the question now is whether these achievements can be added to by applying new transgenic technologies, notably Bt (*Bacillus thuringiensis*) to enhance insect resistance.

2.1 Maize

As Zimbabwe's staple crop, maize is essential to the food economy of the country. Many eat maize meals several times a day, and maize is the preferred grain crop in most communal areas, even those dry areas where it is deemed unsuitable. Since Independence maize production for sale has grown significantly in the communal sector, with some hailing the post-Independence boom as the arrival of an African Green Revolution (e.g. Rukuni and Eicher 1994; Rohrbach 1989). Maize production – both yellow and white – is also important in the commercial sector, although there has been significant switching to higher value crops in recent years. Up to 2001 the large scale, largely white-owned commercial sector was producing perhaps only 20 per cent of the country's white maize requirements down from around 80 per cent at Independence in 1980. Until the recent land reforms, the commercial farms of the highveld in particular were also where most of the hybrid maize seed production occurred. This – as will be discussed below – is a major industry, supplying both hybrids and open-pollinated varieties (OPVs) to both local and export markets.

Maize breeding has a long and distinguished history in Zimbabwe (Mashingaidze 1994; Tattersfield and Hovazvidi 1994). A maize-breeding programme was established in the Department of Agriculture in 1933. By 1949 a double hybrid was released and in 1960 Zimbabwe was the first country in the world to commercially release a singly hybrid maize variety. SR52 was a symbol of the success of Rhodesian agricultural research, and the pride of the white commercial farming sector. The Southern Rhodesian Seed Maize Association was established in 1940 and became an important player in promoting maize growing among commercial farmers. The ten tonne club became a prestigious grouping of farmers able to produce 10t/ha, and breeders in the research system aspired to create varieties that joined the club.

The breeding material developed in this early period has continued to be the base for successful breeding since then. Imports of new genetic material has been important, and in recent years CIMMYT has been an important conduit for germplasm from Mexico and other areas across the world (CIMMYT 2001). While breeding objectives have continued to focus on yield potentials, particularly for the commercial sector in the highveld where supplementary irrigation is possible, other breeding priorities have also emerged. Drought resistance and early maturation have been important as the hybrid maize sector expanded into the communal areas, and the Seed Coop variety R201 became a stalwart for many during the 1980s. In the commercial areas, particularly where winter irrigation occurs, disease/virus resistance has become a major priority in recent years. The rapid response of breeders from both government and commercial companies to the arrival of GLS (grey leaf spot virus), for example, has been witness to the effectiveness of local breeding programmes.

However, up until now, despite these successes, much breeding remains focused on the higher potential areas and commercial farmers. This is where the profits have lain for the private sector players in the maize seed market (see below) and this is also where historically much of both public and private research has been focused. Despite the post-Independence rhetoric of shifting priorities to small-scale farmers and more marginal zones, the standard practices of government breeding programmes have remained largely intact. Due to the high costs of having decentralised breeding programmes, most early

selection takes place in Harare or Gwebi research stations which are both in areas with rich soils and high rainfall. While variety trials do occur across the network of government research stations the chances that traits which perform well in other settings will have been already selected against remains high. Although there have been some donor supported efforts at looking at other traits, including some potentially exciting options being explored by CIMMYT and collaborators (CIMMYT 2002a), the maize breeding and seed production industry although more diversified than before remains focused on a particular market. This, however, is likely to change dramatically, as we discuss below, following the land reform exercise of the last few years, as the scale of farms and objectives of the new farmers has shifted demand in dramatic new directions. Both public and private breeding efforts will have to respond too if the hoped for agricultural regeneration post-land reform is to be realised.

In contrast to most countries in Africa, Zimbabwe has a very extensive use of hybrid maize varieties (Morris 1998; Byerlee and Eicher 1997). This in part arises from the successes of the government breeding efforts from the 1930s, but also due to legislative arrangements established in 1970 with the enactment of the Tripartite Agreement. This was an agreement – only formally repealed in 2001 – between the Seed Maize Association, the Commercial Farmers' Union and Government. It confirmed that the Seed Maize Association would have exclusive rights to government bred seed. In 1982 the Seed Maize and Crop Seed Associations combined to form Seed Coop, an independent operation whose shareholders were the members of associations (mostly large-scale commercial farmers). The Seed Coop also had its own breeding programme (at Rattray Arnold Research station established in 1973) and a new variety testing facility was established under the Agricultural Research Trust Farm. Seed Coop retained the exclusive right to government bred seed (although not the ownership) and built up a formidable (and for much of the 1980s monopolistic) seed industry. This was based on marketing maize hybrids to a wide national market (both commercial and communal), and building up an export market (including deliveries to aid agencies for post-disaster rehabilitation packages in the region) (see Zebre 2001; Rusike 1998; Cromwell 1996).

This basic structure persisted until the mid-1990s. By this time Seed Coop had been privatised (to Seed Co), and a number of new entrants into the seed market were becoming important. Pannar – a South African seed house – for instance flouted the tripartite agreement from the early 1990s, establishing itself firmly in the smallholder maize market. From 1991 onwards a liberalised approach was encouraged, with a variety of local and international entrants setting up in Zimbabwe (Friis-Hansen 2000). It is within this liberalised context, heavily influenced by past events, that the debate about GM options is taking place. Gone are the days of the strong national breeding programme and a parastatal seed production and marketing company. Today, small, new Zimbabwean seed houses must compete with the existing big players like Seed Co, now with regional ambitions, and the established international companies, such as Monsanto or Pioneer Hi-Bred – with life sciences and biotechnology capacities operating on a global scale (Zebre 2001; Gwarazimba 2001).

2.2 Cotton

The story of cotton in Zimbabwe has important parallels with that of maize. Cotton is seen as another local breeding success story, combined this time with well respected and impressive systems for integrated pest management techniques (Mariga 1994; Vaughan-Evans 1990). Post-Independence, the cotton sector has seen a rapid expansion of production in the small scale communal areas, with some areas benefiting from a major "cotton boom" (Worby 1992). The first cotton trial in Zimbabwe was carried out with an Egyptian seed variety in 1903. Later, in 1918, a cotton specialist was appointed to the Agricultural Department who initiated further trials. In 1923 commercial cotton production was started, but it was not until the 1960s that it really took off in a big way. From 1925 the Cotton Research Institute at Kadoma had been working on breeding locally adaptable varieties and developing pest management approaches for cotton (Cameron 1937). In the early 1950s Albar stock from Uganda was imported and the local breeding programme really took off. Being hairy varieties, these were resistant to jassid attack as well as bacterial blight. In 1959–60 Albar 637 was released, resulting in significant yield increases. This and other varieties were later adapted in four regionally specific breeding programmes established in the mid-70s (CFU-Zimbabwe 2002b; Mariga 1994).

Cotton breeding involves selection for a range of characteristics, and in the Zimbabwean government programme a total of 13 field characteristics and 9 fibre characteristics are looked at in the varietal testing stage. Over time average yields in the commercial sector have risen from around 600kg/ha (in 1950) to over 2t/ha in the 1980s. New breeding material is continuously sought from a variety of places, including West Africa, the US, and elsewhere in the southern African region. In all cases breeders report imported varieties perform less well than local ones, but some have proved useful for crossing with local lines. As Mariga (1994: 232) observes 'The research work over the years has benefited from "intelligent technology borrowing" by importing germplasm and interactions with visiting scientists'.

Controlling pests is a major challenge in cotton production. While breeding efforts have certainly helped, these must be combined with pest management techniques. In the mid-50s a system for insecticidal control of bollworm was developed. This was later transformed into a focused target spraying effort based on scouting at various stages in the season. In the early 1970s an acaracide rotation system was introduced, and by the late 1970s experimentation with pyrethroids was initiated. A sophisticated pest management system was thus developed incrementally, using a combination of farmer observation (scouting), selective pesticide application, rotation, and a dead period. The Cotton Handbook published by the Cotton Growers' Association is the "bible" of the Zimbabwean cotton industry. The methods and techniques have been the basis for training and extension since the 1970s when a cotton training scheme was established first at the Cotton Research Institute (1971) and then at the Cotton Training Centre (1979). Commenting on the rigorous approach to cotton production promoted in the country, Vaughan-Evans (formerly of the Cotton Training Centre) observes that 'cotton instils discipline in farmers' (1990, quoted by Mariga 1994).

Unlike maize, however, cotton is produced as part of a much more integrated production and marketing system. Until 1997, the Cotton Marketing Board, a parastatal, offered package services to

farmers in cotton areas, linking the supply of high quality cotton seed to chemical supplies and direct marketing opportunities. A credit package ensured that the system was controlled vertically through the CMB. With cotton production focused in a few key areas, the opportunity for focused extension and implementation of regulations governing pest control measures was possible. The CMB's efforts in the 1980s resulted in a massive expansion of smallholder cotton production in the country. Being hand picked, based on quality seed and with good implementation of pest control measures (split applications, regulated dead period, scouting, etc.) this was a high quality product achieving premium prices in the international market.

Up until the 1990s, then, the cotton sector in Zimbabwe had seen a successful move to the small-scale sector, supported by a state-controlled body supplying top quality R and D and implementing regulated control of seed quality and pest management. In addition, this was a commercial successful business, one of the few able to make a healthy profit out of engagement with smallholder agriculture. In the liberalisation era, therefore, the CMB was one of the early targets for divestment to the private sector. The formation of Cottco in October 1997 resulted in the creation of a strong, at that time, almost monopolistic business (Larsen 2001). Today, there are more players – notably Cargill, Terefin and most recently, FSI Agricom,[2] but Cottco remains the main cotton company in the country, and, in the difficult times of late, has become the "darling of the stock market", with a strong export performance and rising share prices even in a depressed economy.[3] Unlike the maize industry, with its reliance on the large scale commercial sector, the cotton companies have not been hit as hard by the changes created by the land reforms. Indeed, the land reforms should be a major fillip for the industry, although changed arrangements for seed production will require a transition period.

3 Liberalisation and the changing seed industry

The post-1991 period of liberalisation and deregulation is central to any assessment of the context and potential role for biotechnology in Zimbabwe. As already mentioned, the main parastatals in the maize and cotton sectors – Seed Coop and CMB – were sold off during the 1990s. Seed Coop became Seed Co, with a range of investors, both Zimbabwean and international buying shares. While government retained a minority stake, the company operated as a private business, with a separate management structure independent of government. On its creation, Seed Co benefited from the exclusive rights to a range of important germplasm developed in the public sector over many years. Although royalty payments are due

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2 A2 large-scale reallocated farms are increasingly being rented by holding companies such as FSI Agricom and CFI. Politically well-connected, FSI has an MOU with the government to 'produce for the country to ensure food security'. Its cotton-outgrower scheme includes 25,000 A1 and A2 farmers, producing 60,000 tons of seed cotton (*Zimbabwe Independent,* 2 May 2003).

3 See for example: *Financial Gazette* (2001). Cottco emerges as darling of stock market on ZSE. 8 August; *Zimbabwe Standard* (2002). Cottco hit by FCA suspension. 27 November; *Financial Gazette* (2002). Cottco gets exclusive rights in Mozambique. 21 November; *The Herald* (Harare) 2002. Cottco, TSL merger negotiations off. 25 November; *Zimbabwe Independent* (2002). Money market operations boos Cottco bottomline. 22 November. See also www.thecottoncompany.com. However, see Oxfam (2002) for a commentary on the effect of US subsidies on cotton prices and production in Africa.

under Plant Breeders' Rights legislation, Seed Co was quick to establish and register its own lines, and developed an impressive, and profitable, seed house. In the last few years, the company has extended its operations beyond Zimbabwe to supply seed on a regional basis in Zambia, Mozambique and Botswana. Cottco, the successor of CMB, again has government retaining a minority shareholding. Through a licensing arrangement with the government Cotton Research Institute, the company also had access to the publicly bred cotton varieties, although the seed production arm of the company, Quton, has more recently established its own breeding capacity and is awaiting the outcome of decisions on the future of CRI, and whether this might be taken over by the industry and incorporated into the business.

Cottco and Seed Co are the big players in the cotton and maize sectors in Zimbabwe, dominating market shares of seed sales. With the acquisition of 34 per cent of Seed Co shares by Cottco in early 2003, the local industry is increasingly concentrated.[4] But, as mentioned earlier, there have been new entrants during the 1990s, offering different products and entering different market niches. In the maize sector, the South African company, Pannar, made successful in-roads in the 1990s into the small-scale hybrid maize market, through intensive marketing efforts in the rural areas supplying a few good varieties. Pioneer Hi-Bred established a base in Zimbabwe, including some breeding capacity, although it has concentrated on the high value market of yellow maize seed sales in the commercial sector. National Tested Seeds is a new company and has concentrated on open pollinated varieties, initially for export but now with the new acceptance of OPVs, for the local market in alliance with CIMMYT and the Crop Breeding Institute of the Government Department of Agricultural Research and Extension, AREX.[5]

Thus across these companies, the advent of biotechnology means different things. Box 3.1 highlights the strategic positioning of the main players, and their (changing) ideas of what biotechnology means to them.

In the cotton sector a similar story can be told. The main cotton company, Cottco, has through Quton, investigated the Bt cotton option in alliance with Monsanto. This whole endeavour dates back to 1996 when an illegal trial by Monsanto was discovered at the Cotton Training Centre. This was a public relations disaster for Monsanto, and set back their own strategy for release of Bt cotton. Cottco/Quton meanwhile were keen to develop a licensing arrangement with Monsanto to insert Monsanto's Bt construct into a local variety. This too was held up by government concerns over the use of local varieties held by the Crop Breeding Institute. In 2001, trials on Bt cotton were abandoned at the last stage apparently because of on-going intellectual property/licensing wrangles between the parties. Monsanto's restructuring and withdrawal to South Africa also had an impact, giving a clear signal that Zimbabwe was no longer seen as a priority. Quton has been exploring in parallel licensing arrangements with Syngenta for their insect resistance transgenic technology, and, with Quton's increasingly independent breeding capacity

4 *The Herald* (Harare) 2003. Cottco acquires 34pc stake in Seedco. 13 January.

5 The Seed Association of Zimbabwe reported in 2001 that four companies control the maize seed market – SeedCo (78.7 per cent market share), Monsanto (8.3 per cent), Pannar (6.5 per cent) and Pioneer (6.5 per cent) (Zebre 2001: 666, quoting Gwarazimba 2001).

and variety ownership, there is a likelihood of new licensing arrangements developing independent of government.

Box 3.1 Strategic positioning: profiles of key maize players

Seed Co

The major assets of Seed Co as a company are its germplasm, its in-house breeding capacity and its knowledge of the smallholder market. Pre-land reform, it had a dual market with most R and D effort focused on the higher potential areas and the commercial sector, with most high value products sold to this small but significant market. It also sold hybrid maize extensively throughout the communal areas with a high volume, low return strategy. Post land reform the market structure has changed, although Seed Co representatives report high sales of high value seed to the new A2 commercial farmers,[6] and clearly there is a large potential for the sale of hybrid maize to the new farmers in the other "fast track" resettlement areas. Government purchases have distorted the true demand, but indications are that this new group of farmers will be important Seed Co customers in the future. Where biotechnology fits in is unclear. The company does not have the capacity to see through major transgenic developments on its own and has partnerships with both Monsanto and Syngenta. The development of Bt maize has been slow, although one Seed Co variety was tested in 2001 with a Monsanto Bt construct. Negotiations continue with Syngenta for a similar insect resistant transgenic product.

Pioneer Hi-Bred

Pioneer's main market is in the large scale commercial sector where its yellow maizes are popular for feed. With its global network of breeding and product development, it can easily develop new material for this market. However its reliance on the large-scale commercial sector, where technologies from the mid-west of the US can more easily be transferred, is now questioned by the virtual disappearance of its earlier market. Like Seed Co its hope is that the new A2 commercial farmers will take up its products, and potentially, subject to regulatory clearance, transgenic products too. However this remains uncertain, and the commitment to see through a transgenic product development for Zimbabwe seems less likely today than a year or so ago. Although Pioneer tested a transgenic variety illegally on one of its stations, subsequently admitting this "mistake" to the regulatory authorities, it is not clear if this testing programme will continue.

Monsanto

Monsanto, in many ways, faces the same dilemmas as Pioneer. Its profitable market in Zimbabwe had been the large-scale commercial sector, but this now looks problematic. In 2002, the company restructured, withdrawing most of its Zimbabwean operations to South Africa, where the large-scale sector remains a significant and profitable market. In 2001, a Monsanto representative in Zimbabwe was gung-ho. He noted: 'In terms of maize we are set. We have a consolidated genetics. From Ciba Geigy incorporated into Carnia which was bought by Cargill. With the purchase of Cargill we have access to all southern Africa genetics'. But today, there is more reticence about entering the seed market as a main player. As the same representative observed: 'Monsanto is a follower. We will make money from licensing. Our Bt product is the best in the world. Round up ready corn will be a major influence. It is being transformed as we speak. Conservation tillage will be a way of farming for all farmers'.

6 Under the recent land reform in Zimbabwe, two new categories of resettlement have been designated – "fast track" or A1 settlers (essentially smallholders) and A2 settlers who are supposed to represent a new grouping of "commercial" farmers.

Thus, today, the R and D context for seed production, both for maize and cotton, has changed dramatically. Zimbabwe's public sector agricultural research capacity was once the envy of Africa, but is now in serious decline. There has been a collapse of the public research system since the 1980s due to a combination of financial cutbacks, loss of staff and poor management. There is no significant public biotechnology capacity to speak of, at least for advanced molecular and genomic techniques (ISNAR-IBS 1999; Falconi 1999; Komen *et al.* 2000). The Biotechnology Research Institute at SIRDC (Scientific and Industrial Research Centre, Harare) has been the main site for biotech science investments since its establishment (Chetsanga 2001). But, although new labs have been built and donors have backed SIRDC, funds, and particularly staff capacity is very limited. With the withdrawal of donor funding from the country of late, this has become even more problematic, and today only a handful of post-doctoral biotechnology scientists are in post. Other labs, such as the University of Zimbabwe or the Tobacco Research Board, do have some capacity for molecular biology work, but the prospects of new technologies emerging are limited (Falconi 1999; ISNAR-IBS 1999; Chikwamba 1996; Woodend 1995). As one informant noted: 'The private sector has taken over. There is not much public sector left to think about publicly led biotech initiatives'. In sum, in the public sector there is neither the breeding capacity nor the biotech science to really contribute to the independent development of high-end biotechnologies.

The major national asset is, of course, germplasm, protected to some degree by Plant Breeders' Rights held by the government Crop Breeding Institute. However, there has been plenty of leakage of government owned lines to private companies over time. As someone commented, taking some breeders' seed is seen as a good "retirement package" for those moving from the public to the private sector. And with the growth of competing private companies much new germplasm has become part of the scene. The major multinationals can source it globally through vast networks of breeders, research stations and sophisticated communication systems. For example, Pioneer Hi-Bred has only two maize breeders present in Zimbabwe, but over 1000 globally connected through the internet, with the ability to share digital photos of pests/disease symptoms, sequencing data, quantitative trait loci information and so on. The presence of a regional station of the CGIAR centre, CIMMYT, has changed the maize-breeding scene in recent years. One representative of the Commercial Farmers Union noted: 'With CIMMYT you get free breeding materials without paying an extra cent. This is wonderful R and D support for the maize industry'. An industry breeder concurred: 'CIMMYT's genetic material – it's awesome. And it's available for free'. The downside noted by the same informant is that 'it is resulting in decreased breeding effort by companies. This may reduce our genetic diversity and ability to respond in the future'. However, CIMMYT argue that their bottom line is getting good germplasm and new varieties out to small farmers. Alliances with the private sector must be part of this, one CIMMYT staff member argued, otherwise the material just stays on the station.

Given this new context, a big question is how biotech applications might enter the local scene, were they deemed to be desirable. Leaving regulatory approval issues aside (see Keeley and Scoones 2003;

Mohamed-Katerere 2001), what R and D alliances might deliver the new biotechnologies to the Zimbabwean agricultural sector? From our conversations with the full range of players, four possibilities present themselves:

- Public development of new technologies – through national research institutes or collaboration with the international agricultural research system – and licensing to commercial companies for marketing.
- Local development of biotechnology applications by Zimbabwean or regional seed houses.
- Licensing arrangements between MNCs and local seed companies.
- Development by multinational companies of biotech applications and varieties as a package.

At the moment the first two options look far off. The lack of public research capacity makes the first option unlikely, and, to date, no local company has the capacity to undertake the full development of a new biotech product independently. Even more basic applications, such as marker assisted selection (Young 1999), remain off the agenda for the time being, although some local companies are planning to develop such capacity as part of their breeding programmes. Thus the current trends focus on the latter two options, where the multinational companies hold the trump card, with access to the proprietary biotechnologies, which at the moment means Bt.

The degree to which any of these transgenic Bt technologies find their way onto the market is of course another matter. This is dependent on a two stage process involving regulatory approval under the Biosafety regulations, involving at least two to three years of field trials, followed by varietal approval under the terms of the Seed Act, again requiring more field trials. The complexities of working out the terms of licensing agreements between different players adds yet another layer of complication. Thus most commentators in industry are circumspect about the near-future prospect. Most also argue very strongly that the transgenic options being pushed by the multinational life science companies are only one part of the story, and probably only a small part. Most involved in R and D and market development recognise that "good, old-fashioned conventional breeding" is going to be the mainstay of the industry for a long time. If this can be enhanced by such biotechnological techniques as marker assisted breeding or clonal selection then this is a good thing, but not too many hopes should be laid at the door of the biotechnology "revolution".

The way negotiations on transgenic technologies pan out, will depend on the viability of the market, the ability of local companies to hold their own, and the wider corporate strategies of the big players (mergers/acquisitions or strategic alliances), plus the outcome of regulatory processes, and, more broadly, the government's, as yet unclear, overall stance on GM crops. What is for sure, is that the future will depend on wider trends of the corporate seed industry and how this develops in the region (both in southern Africa, but sub-Saharan Africa more generally) as well as globally, more than with the specifics of national governmental policy decisions (cf. Venkatasan 1994; Cromwell 1996; Tripp 2000; Zebre 2001). Thus policy processes and outcomes are very much linked to patterns of private sector development

regionally and globally. The next section look at how these relationships are being articulated around a series of key policy issues central to the biotechnology debate in Zimbabwe.

4 Choices and contexts for the agriculture and biotechnology policy debate

The future of biotechnology in Zimbabwe – and sub-Saharan Africa more generally (with the possible exception of South Africa) – is dependent on a number of factors. This section highlights seven of these.

4.1 Technology choices

A key question posed by many is to what degree are the biotechnologies currently on offer addressing the needs of smallholder African farming? For cotton, Bt may offer a solution to rising pesticide costs and pollution, assuming that these new constructs perform well in locally adapted varieties, that the Bt technology is effective against the local pest complex, that pest resistance does not become a problem and that an effective wider pest management system can be implemented including provisions for refugia (Mayer 2002). A Quton manager was upbeat about prospects: 'We now have a large ginning capacity in the country. We need to ensure production is enhanced. We must get production and yields up, especially in the small holder sector. Biotech may help with this'. Others are more cautious, noting that cotton biotech was not going to be a magic bullet solution: Recalling the early rhetoric a commercial Cotton Growers' Association official commented: 'Monsanto came in and said Bt cotton was going to solve everything. But you can't plant Bt cotton and go fishing for the season'.

However, on the benefits of Bt maize, many are more equivocal. Especially in the small-scale sector, stalk borer infestation is not the top priority problem. As one seed company official argued: 'for stalk borer the chemicals are cheap and effective for many farmers, why would they want to pay significantly higher premiums for genetically engineered seed?' Issues of drought resistance and soil fertility, for example, are far more key production constraints than pest attacks of any sort (CIMMYT 2002b). No-till options with herbicide resistant (e.g. Round-up Ready) maize are also not seen to be of a high priority outside the commercial sector where labour and diesel fuel costs may be high.[7] Thus, in many people's views, the maize biotechnologies being tested are not necessarily the right ones for Africa – and certainly not the poorer more marginal farmers who constitute the vast majority of the population. As the managing director of a major local seed house put it: 'drought tolerance, acid soils, low soil fertility are just not on the radar screens of the US companies . . . African [biotech] solutions are not coming in the medium term. We will get spin-offs from the US markets, that's all'.

In the absence of significant national, regional or even international public R and D capacity, the degree to which technologies for African smallholder settings become available will depend in large part on whether the industry can secure large enough viable markets to allow for upstream Africa-specific

[7] However, this may change as labour shortages are increasingly a constraint in the small-scale sector as HIV/AIDS takes its toll.

R and D investments. If not (which given the fragmentary, imperfect, and poorly regulated markets of much of sub-saharan Africa seems likely), then the likely biotech applications will continue to be "spillovers" from R and D investments designed for the commercial farms of the Americas. Only if public sector science can deliver some useful products (which in the advanced biotech field at the moment looks way off), then will technology choices with higher priority for African producers find their way onto the market, perhaps through new forms of public-private partnerships such as those being proposed by the newly established African Agricultural Technology Foundation based in Nairobi and sponsored by the Rockefeller Foundation, with support from Monsanto and DuPont among others.[8]

4.2 Technology access and ownership

Beyond the choice of technology, issues of access and ownership are central to current debates. At the moment, with very limited capacity for new biotechnology development outside the MNCs, as we have already observed, government and local companies alike are reliant on licensing arrangements with the big players in order to gain access to the new technologies. Intellectual property is fiercely guarded and complex agreements must be reached for both research and commercialisation. In most cases any genetic transformation must be undertaken in the labs of the parent company, often in the US. Although no commercial license arrangements have been negotiated as yet for Zimbabwe, the biotech companies are holding out for a large share of royalties from any transformed product. For them it is the genetic engineering transformation where premiums accrue, and the value of the background germplasm is less of a concern. Those who have invested a lifetime in breeding locally adapted crops argue otherwise, pointing out that Bt will only perform well if in an appropriate background. As one senior industry person put it: 'We are overplaying one gene because it came from a lab and undervaluing the genetics that underlie it'. In a similar vein a senior government official commented: 'It takes 10–15 years to develop a variety. You add a gene for 10 per cent yield increase. Why should they get 90 per cent of the profit?'

Since it is the MNCs who (largely) own the biotech constructs and the local companies who have access to the germplasm, many foresee some future intensive wrangling over rights and ownership, royalties and licenses. Indeed this has already happened, and negotiations have been fraught according to some of those involved, with breakdowns occurring due to lack of agreement. A cotton industry commentator argued 'We would bargain for a 50:50 share at the minimum. The variety is more important than the Bt'. To date, as discussed earlier, only a limited number of arrangements – all pre-commercialisation and without detailed negotiations over technology fees, seed pricing and so on – have emerged, with Seed Co and Cottco developing joint R and D efforts with Monsanto and Syngenta.

The early experience of a joint venture between government and Monsanto for the development of Bt cotton was not a good introduction. A government official involved in that discussion recalled: 'We had protracted discussions with Monsanto over Bt cotton before. Because they are owners of this gene, they want everything'. However, a local Monsanto manager complained: 'The earlier joint venture failed

[8] See *Washington Post* (2003) 'Feed hungry Africans, firms plant seeds of science', 11 March.

because there was no ability to strike a deal. It got bound up in sentimental issues. Government does not have a business frame of mind. There are still people sceptical about GMOs in government. For things to move there needs to be revolution in government'.

At the moment what appears more likely is that, given the difficult relationships between private industry (particularly multinationals) and government, new deals are likely to be struck with local companies, using their own germplasm, rather than with government directly. Quton, for example, have begun to negotiate with Syngenta to develop cotton varieties using the corporation's VIP technology. Unlike with Monsanto it appears that transformations will happen locally in Zimbabwean laboratories, and more appropriate licensing arrangements will be agreed.

With these joint ventures, licensing arrangements and cooperation on R and D, the patterns of ownership and so control of technology development in the Zimbabwean seed sector are set to change dramatically. With companies increasingly keen to assure their proprietary rights over technologies developed at considerable cost, the implementation of patent provisions becomes increasingly important. The degree to which these can be upheld in the Zimbabwean context remains uncertain, and companies wishing to invest in biotech applications need to be assured. This uncertainty means, in many cases, that the technologies being offered to local companies in joint arrangements are those which are perhaps not the top end products offered to other markets.

In parallel to patent protection of transformation events and biotech processes, the assurance of plant breeders' rights on the background variety into which new transgenic events are inserted becomes a concern. While PBR legislation exists, and a thorough process of registration prior to release is in place, the degree to which this offsets all attempts at appropriation of locally developed germplasm remains questionable. Rights of farmers to their own germplasm is also another issue which has been raised by NGOs and taken up by government in Zimbabwe (Commutech 1998a,b; 1999). New legislation is being drafted currently which aims to provide protection to farmers' rights, and would require a parallel registration process to those existing for varieties bred by scientists. While the desirability of protecting farmers' own breeding and germplasm protection efforts is not doubted, the practicability of such legislation in the Zimbabwean context is not at all clear.

With ownership and control becoming so central to the future of technology development and the seed sector, the question of rights – and particularly property rights – has, then, been put centre stage in the policy debate. This requires a sea change in the attitude to seeds and plant breeding by professionalised plant breeders and farmers alike. As one commentator put it:

> The notion of individual rights flies in the face of the way things work here. People are proud to share their germplasm. Look at the success of the seed fairs promoted by NGOs. Breeders can get good material there, especially of minor crops where there are no established varieties. And farmers are happy to share it.

4.3 The new farmers – consequences of changes in the agrarian economy

In Zimbabwe the mainstay profit base of seed sales to the old-style, largely white commercial sector has effectively ceased. Most former white farms have been taken over for resettlement, transferring the land to a mix of smallholder farming and new commercial farms of varying sizes. The degree to which these new farmers will become a vibrant local market for seed sales is unclear. 2002 saw the largest ever demand for maize seed with 49000MT purchased, including a substantial proportion by government to support new farmers. In addition new farmers in the large-scale (so-called A2) schemes have been purchasing high quality seed from the seed houses. If the start-up transition problems of the new resettlement areas can be tackled, and those who acquired land but can not make use of it perhaps transferring to others, there is a likelihood of a growing demand for maize seed nationally. However, as with the communal areas over the past few years, the ability of new settlers in the smallholder "fast track" (A1) schemes to purchase high value hybrid seed is unclear. Instead, a greater demand for open pollinated varieties – now for the first time since before the hybrid revolution of the 1950s being actively encouraged by government – may grow. These, however, are unlikely to be the background varieties for any transgenic application (due to proprietary protection concerns, see above). Such products, with their potentially high technology fees and being based on only high quality hybrid material, will be only associated with the commercial sector, at least for maize.

Perhaps the major impact of the land reform on the seed industry has been the transfer of commercial farms that were the base for seed production. Despite intensive lobbying of government, these were not retained and most have either been resettled or are subject to compulsory acquisition orders. The consequence has been the need for a rapid rethink of the seed production strategy on the part of all companies. Many have diversified their operations outside the country, making use of land in Zambia, Mozambique and South Africa. Within Zimbabwe, Seed Co for instance has contracted out seed production to new farmers on those farms previously used. While accepting that production levels and quality issues may be compromised, even in the 2003 production season around 5,000 ha was planted nearly all in new farms with an expected level of seed production of around 11,000 tonnes. With future investment in training and extension, the company hopes that this target can be increased to meet domestic seed needs. For cotton, Cottco has moved from a situation where 110 commercial farmers provided nearly all the cotton seed for the company to one where only nine of these farmers have continued cotton seed production and this has been contracted out instead to a network of around 15,000 smallholders, all with a long-term association with Cottco, across the country. Unlike maize, of course, where isolation distances and a more complex production process is required, cotton is certainly more amenable to small-scale seed production, but nevertheless this is a major shift for the company requiring compensatory investments in a range of support services for the new seed producers.

4.4 Seed markets

Much of the discussion about the pros and cons of GM crops may be purely academic if there is no market for high-end, transgenic biotech products. Clearly the bigger seed companies and biotech majors believe there is a market out there, but this is by no means sure. Understanding the local market is of course key to business success and central to any targeted R and D strategy. And, as we have noted, this market is fast changing in Zimbabwe with a whole new client base in the new farms created following the land reform. A local industry person observed: 'The big technology companies have a large farmer mindset. They think the market here looks like the US, Argentina, Australia. It doesn't'. In Zimbabwe the successful seed houses very consciously divide their market between a low volume, high quality, large margins market in the large scale commercial sector and a high volume, lower quality, small margins market in the communal sector (McCarter 1998). A seed house MD pointed out: 'We sell seed like soap, sugar or coke. It is not like the US where salesmen trail around'.

This applies elsewhere in Africa, but perhaps with an even greater reliance on a disparate, poorly organised small-scale sector, where margins are low (with the obvious exception of South Africa which has maintained a large-scale commercial maize sector, and a few other countries such as Zambia and Mozambique which are trying to galvanise one). The degree to which a top end biotech product with a significant technology premium (some estimate up to 10 per cent) can be sold on to this sector is very uncertain, even if the benefits exceed the premium.

There are other practicalities also. A local seed industry commentator asked: 'Do you think for a 10kg bag of seed sold in a remote rural store every farmer is going to fill out a three page license agreement?' Beyond licensing arrangements required, broader regulatory approval may present hurdles for investment. As one commentator put it:

> The costs of regulatory approval in the US for one biotech product are as much as the profits of the whole private sector seed industry in Malawi. They are not going to invest under such a situation. All we can hope for is a spillover from South Africa where there is a decent market.

With poorly developed credit markets, and low capital availability among smallholder farmers, the option of buying relatively expensive premium grain seed is available only to a few. As one industry sceptic put it 'Bt will double the price of seed. This is impossible in the small-scale market. And high input commercial farmers are only 2 per cent [from 2002 even less] of the entire market'. While the experience of Zimbabwe's hybrid maize farmers is used as a counter argument, this may be a peculiar example. While such farmers may well fully appreciate the value of the new product, just as they have appreciated hybrid maize, they may not be able to afford to use it except on certain portions of their farms in certain seasons (or under irrigation). This may not be a very big market, and so will act to decrease the incentive for any company to invest in new R and D, even if aiming for a product with greater market potentials. In South Africa for instance hybrid maize seed can sell at US$2 per kg, in Zimbabwe it would only be 20 cents in

the smallholder sector. The margins are thus significantly different, and there is no possibility of charging the South African technology fee of 80 cents per kg for Bt products to Zimbabwean small-scale farmers.

The cotton sector, though, may be somewhat different. Here production is often focused in particular areas, with a close developed between production and marketing, often overseen by a single company. In the case of Cottco, for example, an input package is supplied and a guaranteed sale channel offered to producers. This has allowed cash-starved smallholder farmers to acquire the necessary inputs and successfully grow cotton on a significant scale. With such a structure the possibilities of supplying Bt cotton seed with a premium price may be more feasible than in the maize seed market. Monsanto point to the "success story" of Makhatini in South Africa as an example of the rapid uptake of Bt cotton seed, with farmers reaping significant economic gains (Ismael *et al.* 2001a,b; Kirsten and Gouse 2002; Buthelezi 2001).

4.5 Industry structure and ownership

A pattern repeated in many parts of the world has been a rapid consolidation of the seed industry around a few major players. A local seed house manager commented: 'If you are not in bed with the right people now, you are not existing in the seed market'. To date the process of consolidation has been slow in Zimbabwe, and similarly elsewhere in the region. But will this remain the case? People we talked to were fairly uniformly convinced that consolidation – either through direct take-overs or increasingly tight joint ventures or linked licensing arrangements between local players and major MNCs – was the future, although the time frame over which this would happen was less clear.

Companies like Seed Co, with a traditional national state-owned seed house origin, have been expanding significantly in recent years, diversifying their operations and acquiring stakes in companies in many nearby countries.[9] They argue that, without a region-wide base, the chances of survival in a small market with a volatile and uncertain economy like Zimbabwe is slim. The windfalls of aid support for seed packages (for Angola and Mozambique, for example) in recent years have been important injections for many companies producing open pollinated maize varieties, but as a stable base for the company these opportunities cannot be relied upon.

Given the current state of the Zimbabwean economy and the uncertainty created by the current political turmoil, it is unlikely that major take-overs by MNCs of local firms will occur in the immediate term. However, the recent acquisition by Cottco of 34 per cent of Seed Co's shareholding is an indication, that, at least locally, the trend towards consolidation is continuing.[10] The combined R and D, seed production and marketing efforts of Cottco/Seedco may present a formidable local and regional company that may be able to stand up to and even compete with the bigger international players.

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9 See for example: *Daily News* (Harare) (2002). Mozambique accepts Seedco hybrid seeds. 29 April; *Daily News* (Harare) (2002). Poor performance threatens Seedco's regional position. 19 November; *Zimbabwe Independent* (2002). Brokers trim Seedco forecasts. 11 October. See also www.seedco.co.zw

10 *The Herald* (Harare) 2003. Cottco acquires 34pc stake in Seedco. 13 January.

4.6 Economic conditions

The current economic crisis has seen the collapse of the Zimbabwe dollar, and the development of a strong parallel currency market, where the US dollar trades at 200 times the "official" rate. This makes conducting business very tricky when exchange rates have to be calculated across multiple levels. A substantial devaluation of the dollar will certainly make Zimbabwean products cheaper internationally, and for exporters this may result in increasing competitiveness. However, the downside may be continued rising inflation (estimated at 175 per cent in early 2003 and expected to rise to up to 500 per cent pa) and increasing costs of imports. This is of course particularly problematic for local companies trading in Zimbabwe dollars. By contrast multinationals, with access to hard currencies can weather the storm, and indeed profit by it on occasions. But perhaps more than the specifics of exchange rate fluctuations, inflation and devaluation it is the uncertainty created by such a depressed economy that makes doing business in any sector a difficult challenge, particularly for local companies without the scale of a multinational corporation to offset risks.

With the current food crisis stretching government resources to the limit and with aid flows to Zimbabwe having dried up in 2002–3 due to a variety of sanctions against the Mugabe regime, the prospects of substantial amounts of money – if any – being offered to public sector R and D in agriculture are remote. Even before the politically motivated sanctions the non-payment of past loans meant that the government has been blacklisted by the World Bank/IMF. The result was the cancelling of proposed loan-backed public investments in agricultural research, and a dramatic decline in project based funding for public sector biotech work. While some funds trickle through on the back of regional projects, international networks and individual grants and fellowships, significant support for capacity building, infrastructure development and basic research in the biotech area have been put on hold. While this may be a temporary phenomenon, the slow development of biotech capacity in the country has been undermined. Returning PhD graduates find labs without equipment and resources, and, unsurprisingly, they seek alternative options outside the country. The combined consequences of economic slowdown (with high inflation and declining real wages in the public sector) and lack of top up aid money has meant that the attractiveness of a public sector career in science (particular biotech science with such international demand and an eager private sector willing to pay significantly higher salaries, often in foreign exchange) has declined dramatically.

Thus, despite the impressive commitment of a few key leaders, the prospects for a revitalisation of public sector research in the near future is slim. The relatively limited international public funds in this area seek out countries where there is a better combination of economic and political stability and a more concrete commitment to biotechnology from government. In this regard Zimbabwe has lost out to Kenya in the last few years which, through the advocacy of heads of the national agricultural research system (KARI) and alliances with biotech industry (through ISAAA and others) have presented themselves as sub-Saharan Africa's agricultural biotechnology leaders, much to the chagrin of Zimbabweans working in this field.

4.7 International trade and GM choices

The final factor we wish to highlight – that of the impact of international trade concerns on GM options – has come to particular prominence in the Zimbabwean context in the past year or so. With Zimbabwe being GM-free at the moment, what are the consequences of going down a GM route for trade? A number of concerns have been raised. During 2001, it was beef ranchers in the large-scale commercial sector who were raising concerns through their Commercial Farmer Union commodity association (CFU-Zimbabwe 2002a). Would EU markets accept Zimbabwean beef, if feed became GM? The (pre-Foot and Mouth outbreak) EU market was considerable, valuable and protected. Grain producers also raised concerns, as some of their products might no longer gain GM-free status (e.g. exports to South Africa for baby food). Cotton producers did not seem to worry as much, as their exports were largely high quality lint and so not for consumption, while all edible products of cotton production (oil, seed cake) are consumed locally. Other producers have also raised concerns, including those involved in the horticultural trade where a GM-free, if not organic, premium can be raised in certain export markets.

These concerns, while discussed, only became a really hot issue when the importation of GM food aid was being mooted. As many surmised, an uncontrolled importation of whole grain maize for food aid could quickly result in the country being viewed as a GM producer due to informal planting, even before any formal commercial releases were granted. Thus in the debates surrounding food aid imports, trade became a key touchstone. With the pressure heightened by the US, many feared that the GM food imports would be simply commercialisation by the back-door, without due attention to the procedures of the regulatory process.[11] Despite assurances from the EU and others that GM feed would not prejudice beef markets and that particular transgenic events were not covered by the moratorium in Europe,[12] people were sceptical. This looked to many as a set up job, with a heavy-handed trade imposition being handed down in the guise of humanitarian aid. In the end the Biosafety Board rule that GM maize could

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11 For both international and Zimbabwean press commentaries, see, for example: IPS, *Inter-press service* (2002). Die of hunger now or eat and die later. August 26; *IRIN* (2002). Zimbabwe: GM maize accepted as crisis deepens. 6 September; *Reuters* (2002). Starving Africa should accept GMO food, US says. 29 July; *Reuters* (2002). US calls food aid refusal a crime against humanity, 9 December; *SciDevNet* (2002). African hunger and GM maize. www.scidev.net/archives/editorial/comment28.html; *The Economist* (2002). Better dead than GM Fed. Economist, 23 September; *The Independent* (UK) (2002). US policy on aid is "wicked", Meacher. 1 December; *UK Independent* (2002). Row grows over GM food aid for Africa as 14 million starve. 19 October; *Washington Post* (2002). Starved for food, Zimbabwe rejects US biotech corn. 31 July. For a flavour of the US position, see: US Department of State (2002). Zambian rejection of US food assistance. Statement by Richard Boucher, Spokesman. Press release, 30 October or USAID (2002). Confusion on biotech affecting famine, trade, official says. USAID press release, 16 December. www.usaid.org UN agencies, including WFP, WHO and FAO were under intense pressure to follow the US line. See for example statements: WFP (2002). WFP policy on donations of foods derived from biotechnology (GM/biotech foods). Agenda item, 4. Policy issues. Executive Board Third Regular Session, Rome 21–25 October. WFP: Rome; FAO (2002). Director General urges countries to think carefully before rejecting GM food aid. FAO Press Release, 30 August. FAO: Rome. www.fao.org/english/newsroom/news. Also: Agence France Presse (2002). WFP grapples with GMO dilemma in southern African food crisis, 24 July; AllAfrica.com (2002). WHO urges acceptance of GM food aid. 28 August. See also GRAIN (2002), Greenpeace (2002), Fakir (2002) for critical commentaries on the US position.

12 Berglund (2002). EC clarifies its position on GMOs. Press Release, Lusaka 28 August. Delegation of the European Commission: Lusaka.

be imported as aid, but only if milled in advance or immediately after entering the country (see Keeley and Scoones 2003).

With the changing structure of farm ownership and land unit size, the possibilities of aiming for a segregation scenario was also looking increasingly problematic. Certainly for maize, but perhaps less so for cotton where there are only two varieties and a highly controlled production-marketing-ginning system. In the past some Commercial Farmers' Union representatives argued that segregation for all crops was the route to go, with careful tracking and separation of GM and non-GM products, and isolation distances between different crops being maintained. In the large-scale sector where farm sizes are huge, production and marketing chains tight and on-site monitoring feasible, this option looked like a possible compromise, where niche markets could be maintained depending on consumer and regulatory preferences in export countries. However, seeing this through in the new post-land reform situation is far from clear, only adding to the view expressed by one industry informant who said their approach was to: 'wait and see what the government decides. And this will only happen when the US and EU decide'.

Thus, in the policy debate on GM seeds, it is not only the national context that matters. The ongoing tussle between the EU and the US casts a strong shadow on national decision-making and commercial options. This trade dispute, then, is being played out in southern Africa through (implicit and apparently otherwise) threats over aid flows and broader trade relationships. It has also entered the dynamics of response and the intense politicisation of an international humanitarian response to a major regional food crisis. The future of biotechnology choices in Zimbabwe, therefore, are very much wrapped up in a global contest between industry, governments and consumers, often far removed from the poor, smallholder farmers that this technology is supposed, according to the pro-biotech rhetoric at least, to benefit.

5 Future scenarios

During our discussions of these themes with a range of actors in Zimbabwe, four broad scenarios of the future of agricultural biotechnology and the seed industry were talked about. Told as stories, these create a series of policy narratives, each associated with a set of framing assumptions, and linked to a network of policy actors. No-one believes any one of the storylines will become reality in as neat and tidy a way as they are told, but the narrative provides a justification for action, and an umbrella for the development a coalition of players interested in promoting a particular policy trajectory.

5.1 Scenario 1

The private sector can make money from the small-scale sector in Africa. In Zimbabwe for instance 35,000 tons of hybrid maize seed were sold in 2001 and 49,000 MT in 2002, mostly to small-scale farmers, a figure higher than the whole of South Africa. If farmers in Zimbabwe can recognise the value of improved technologies and pay for it, then why not, so the story goes, in Mozambique, Zambia, Malawi and the rest of the region? With farmers already showing long-term commitments to new technologies, with widespread recognition of the benefits, why would they shy away from biotechnologies, and Bt maize

or cotton in particular? The case of the widespread adoption of Bt cotton on the Makhatini flats in Kwazulu Natal in South Africa shows the potential viability and attractiveness of Bt technologies. A liberalised, but well regulated, market is the route for private sector investments in a range of joint venture, licensing and other arrangements. MNCs will be key in bringing the benefits of new technologies to Africa's poor, but only in conjunction with solid conventional breeding programmes to provide good quality background material, it is argued. A restructured seed industry, with take-overs of inefficient state run enterprises, and joint initiatives with local private players, will deliver the results. As markets develop, new products will come on line spreading the gains of an engagement with a global industry to the smallholders of the region.

5.2 Scenario 2

An increasingly consolidated seed industry with MNC domination (at least at the biotech end) will reduce choices. Seed markets will become entrapped in broader needs to recoup R and D costs on global biotech investments. With shrinking markets elsewhere (due to regulatory hurdles, public disquiet over GM etc in Europe for example), Africa becomes critical to the global ambitions of the biotech industry. Making sure that Africa goes GM is a key part of company strategies (and by extension US government policy), as this will ensure that there will be fewer and fewer non-GM zones globally, putting pressure on the Europeans to come into line. Thus, for the long term, accepting Africa as a loss-leader makes good business sense. This is why such companies may accept lower technology fees and small returns. However, control of the industry is a key objective. Aggressive take-overs of local firms will tend to reduce choice and remove R and D from local settings towards generic products developed for bigger markets. New contractual arrangements will entrap farmers into a particular set of obligations (linked to credit, marketing and seed/technology use agreements) through the growth of contract farming/out-grower arrangements to ensure that markets are created. This will divert R and D investment from conventional breeding and squeeze out competition in the seed market, driving input prices upwards, even if some costs come down through the new technologies.

5.3 Scenario 3

Public sector research investments on a regional basis, linked to international organisations must increase to deliver the type of biotechnology products that farmers really demand. Simple market mechanisms will not deliver this. Agreements on intellectual property (IP) transfers will have to be made with commercial companies in order to secure access to technologies and processes for this research, however (as envisaged by the African Agricultural Technology Foundation). These may be available for non-priority crops (e.g. sweet potato, cassava etc.), but probably not for maize or cotton. However, for these crops, if public research invests in traits that the major MNCs are not interested in (such as drought tolerance or responsiveness to poor soil fertility), then deals may be made with the MNCs for the development and marketing of products to markets that, while they are not their priority, will potentially extend their market

share. Concerted investment in public sector research, then, is a key priority, and should be focused only on areas where the private sector big players have no major interests. This is a longer term project which must be started now to ensure food security for the poor.

5.4 Scenario 4

Agricultural biotechnology – and in particular transgenic crops – will be a commercial flop in Africa, even in somewhere like Zimbabwe with the tried and tested hybrids market for maize and the long tradition of using purchased seed for cotton. Markets are thin, producers are poor and the product available will not be attractive to those without significant capital assets and buffers against risk. With increasing number of rural people suffering increasing levels of livelihood vulnerability, and with less and less ability to raise cash and take risks, the market for biotech products will be minimal. The changing patterns of input purchase (improved seed, chemicals, fertilisers) in Zimbabwe is a key indicator of this trend. The ability of commercial companies to operate a successful regional seed market north of the Limpopo will continue to be constrained by both the scale and diffuseness of the market, high transport costs and diverse national regulatory regimes. In addition, continued domestic and perhaps more significantly international worries about biosafety of GM products will mean that biotech applications will concentrate on the low-tech end – tissue culture and marker-assisted selection, for example – where regulatory concerns are negligible, and there are no worries about export markets. This will be compatible with continued public sector involvement (such lower end biotechnologies are cheaper and less bound by intellectual property protection) and local commercial enterprises (for the same reasons, and perhaps in alliance with public sector players, and international organisations) may be able to make a go of it.

While not articulated fully, or with such certainty, elements of each of these scenarios were related to us in interviews by different policy actors. Some confidence in the private sector solution (scenario 1), not surprisingly, was presented by MNC representatives, and with a degree more scepticism by larger local seed houses (although they saw conventional seed markets persisting without biotechnology, and biotechnology simply as one element of a larger portfolio, including open-pollinated varieties).

The pessimistic vision (scenario 2) was also relayed by some in the seed industry, who foresaw a rather limited future for the local/regional seed industry as currently constituted. Outside South Africa, the challenges of developing effective, regulated seed markets was seen as limited, and the prospects for MNC domination high. Take-overs, they thought, were almost inevitable, with local operations concentrating on niche markets where the scale advantages of MNCs were not apparent. A similar scenario, although with a different political spin, was painted by some NGO representatives and government commentators. Seeing limited potentials for national leverage given the broader policy of liberalisation this scenario was seen as likely, with major negative consequences for the seed industry and agriculture more generally.

Some in this grouping, however, added a more positive view, although one that might arise in the medium to long term. The conditions for this, though, were seen to be at present unlikely – essentially the

availability of significant public funds sourced internationally, and a mechanism for regional coordination of research efforts (scenario 3). More likely, these commentators, pointed to the final scenario which foresees a low-tech biotech future, where public and local private sectors would both have a role.

What scenario – or more likely combination of scenarios – will ultimately emerge will depend on the type of policy issues, contexts and trade-offs highlighted earlier. It is around these themes that public policy debate needs to develop, both in Zimbabwe but also in Africa more generally, in ways that are more sophisticated and nuanced than the current slanging matches between pro and anti-GM lobbies. The outcome may well be highly differentiated – for different crops, agro-ecological zones, socio-economic groups of farmers, and countries with contrasting economic structures and patterns of trade relations, the choices will almost certainly be different. But for the future of African farming, and particularly that of smallholders, an engaged and informed debate is vital. We hope that this paper is a small contribution to this debate.

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