

GM cotton in Africa:

Battleground between Chinese and US capital

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On 7 April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity (ACB). This name change was agreed by consultation within the ACB to reflect the expanded scope of our work over the past few years. All ACB publications prior to this date will remain under our old name of African Centre for Biosafety and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture systems in Africa and our belief in people's right to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and their right to define their own food and agricultural systems.

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Acronyms

| | |
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| ABNE | African Biosafety Network of Expertise |
| ACB | African Centre for Biodiversity |
| ACTESA | Alliance for Commodity Trade in Eastern and Southern Africa |
| AGOA | African Growth and Opportunity Act |
| Bt | Bacillus thurengiensis |
| CmiA | Cotton made in Africa |
| COMESA | Common Market for East and Southern Africa |
| ECOWAS | Economic Community of West African States |
| EU | European Union |
| GM | Genetically modified |
| GMO | Genetically modified organisms |
| IAASTD | International Assessment of Agricultural Knowledge, Science and Technology |
| ICAC | International Cotton Advisory Committee |
| ISAAA | International Service for the Acquisition of Agri-biotech Applications |
| MFERIT | Ministry for Foreign Economic Relations Investment and Trade (Uzbekistan) |
| NEPAD | New Partnership for Africa's Development |
| US | United States |
| USAID | United States Agency for International Development |
| USDoA | United States Department of Agriculture |
| WEMA | Water Efficient Maize for Africa |



About this paper

This paper provides an overview of the GM cotton push in in East and Southern Africa, within the context of the global and regional cotton markets. It provides details and snapshots of which countries in East and Southern Africa are in the process of commercialising GM cotton and describes the agents and private sector drivers involved in this effort. It highlights what is already known to have occurred with the adoption of genetically modified (GM) cotton in Africa, particularly its impact on small-scale farmers. It explores the organic cotton market as a possible alternative to both conventional and GM cotton production.

Introduction

The biotechnology industry-linked International Service for the Acquisition of Agri-biotech Applications (ISAAA) refers to Africa as the ‘final frontier’ for biotechnology (Food and Water Watch 2013). African countries, except South Africa, have been reticent to adopt genetically modified (GM) crops because of opposition from farmers, consumers and civil society at large. However, in the recent past, there has been a shift, with 13 African countries planting, undertaking field trials or granting approval for general release of GM crops in 2016. Of these, only South Africa and Sudan cultivate GM cotton commercially, with commercialisation expected in Ethiopia, Malawi and Kenya in 2018/19.

South Africa started producing GM cotton in 1997 (Afrificio n.d.). Zimbabwe started conducting confined GM cotton field trials in 2000, but abandoned them in 2005. Tanzania is conducting field trials for GM drought tolerant maize under the auspices of the Water Efficient Maize (WEMA) project, with plans to commercialise GM maize seeds in 2021 if the strict liability regulations of its National Biodiversity Framework are further relaxed (Ezezika et al. 2012). Uganda is currently conducting confined field trials for GM cotton (NEPAD-ABNE 2017).

Kenya’s National Biosafety Authority, in defiance of an order by the health minister, granted approval for GM cotton open field trials in August 2017 (Andae 2017), with commercial release of seeds expected in 2019 (Kenya News Agency 2017). In 2016, Malawi approved the environmental release of GM cotton and open field trials are underway at nine sites, with commercialisation expected by 2019 (Chaweza 2017). Mozambique is not yet experimenting with GM cotton, but started its first confined field trials for WEMA drought tolerant/insect resistant maize in early 2017 (NEPAD-ABNE 2017). Efforts are also underway to relax Mozambique’s biosafety regulations. Zambia is in the process of relaxing the strict liability clause in its Biosafety Act of 2007, to start experimenting with GM cotton (ACB 2017) and efforts are underway to revise its National Biotechnology and Biosafety Policy as the first step towards this end. Swaziland started field trials for GM cotton prior to a regulatory framework being in place and commercialisation of three GM cotton varieties is expected as soon as its National Biosafety Act is amended (Observer 2017).

In Ethiopia, where GM cotton field trials are underway (Koigi 2016), GM cotton production is targeted at large-scale commercial farmers, as the government wants to position the country as a leading exporter of GM products on the continent. Ethiopia is set to begin commercialisation of GM crops following the relaxing its Biosafety Proclamation.

From the early 2000s onwards there has been a concerted effort, led by the United States (US) and its varied agencies, as well as ‘philanthropic’ organisations such as the Bill and Melinda Gates Foundation, to pave the way for multinational seed and agrochemical companies to establish themselves in Africa. These initiatives include the US Agency for International Development’s (USAID) Feed the Future initiative and the Gates Foundation-funded Alliance for a Green Revolution in Africa. In 2011, USAID announced that its agribusiness champions, including Monsanto, Syngenta, Yara International, Cargill and BASF, would help it to fulfil its new vision for agriculture (Pesticide Action Network 2011), built around GM crops and massive profit margins for

the companies that supply GM seeds and associated agrochemicals.

A Food and Water Watch report in 2013 analysed the contents of the leaked diplomatic cables between 2005 and 2009 from US agencies to its embassies abroad. It concluded that the campaign to extend the interests of biotech companies in Africa has been coordinated from the highest levels, with some instructions being given by then Secretary of State Hilary Clinton (Food and Water Watch 2013). Guidance was given to various US government agencies on how best to position such crops – aligned with solving problems of hunger and poverty – and to provide technical support and other resources particularly to those countries in the process of amending their biosafety regulatory frameworks. Through agencies such as USAID, the US has provided financial support for Monsanto's field tests, negotiated with governments regarding royalty payments, and pressured governments to amend their legislative and regulatory frameworks to allow the US entry to markets (Food and Water Watch 2013). The Gates Foundation has also been a significant player, for example, providing Ghana with \$6 million in funding to implement its biosafety law in 2012, (Food and Water Watch 2013).

The US has concertedly promoted GM crops and marginalised more sustainable alternatives, despite the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD)'s 2009 report that notes that GM-based agriculture is a poor choice for the developing world, because of the high input costs of GM seeds and associated chemicals, uncertain yields and its potential to deepen localised food insecurity (Food and Water Watch 2013).

While Monsanto has a stranglehold on the GM cotton provision on the continent (including in Burkina Faso, where GM cotton was grown commercially for a number of years), Syngenta mainly services the West African market and Bayer sells only in South

Africa, but is conducting GM cotton field trials in Cameroon (Maritz 2014). In East and Southern Africa only Kenya, Malawi and South Africa are using or trialling Monsanto's Bollgard II variety. Swaziland is looking to release Indian GM cotton varieties, Sudan is using a Chinese GM cotton variety (Sudanow 2017), and Ethiopia has sourced seed from India and Sudan. Ethiopia chose not to use Monsanto's varieties, because Monsanto did not want to go through further laboratory and field tests, claiming their effectiveness had already been proven (Kifle 2016).

The upcoming mergers (Bayer-Monsanto, ChemChina-Syngenta) are likely to shift the seed landscape on the continent because of the increasing partnerships between African and Asian countries; particularly with India and China, which have both developed generic Bt cotton technology. While Bayer as a single entity may have worked to gain access to African markets with its Liberty brand, and thereby offered competition to Monsanto by lowering the cost of GM seed for farmers, in future years as a merged entity it will benefit from a combined research and development portfolio and Monsanto's extensive footprint in Africa.

China is a major trading partner for many African countries and a major source of foreign direct investment and aid (Cerier 2017). One of the public intentions behind state-owned ChemChina's acquisition of Syngenta is to plant GM crops on a very large scale. There are an increasing number of in-country partnerships to share technology and expertise in Africa, including 25 demonstration centres¹ that will provide inputs to African farmers. An example is the China-Africa Development Fund's China-Africa Cotton Development Ltd. The company has fully owned subsidiaries in Malawi, Mozambique, Zambia and Zimbabwe, and is the largest cotton company in Malawi and one of the three largest in Zambia. It owns seven ginneries, two cotton seed oil extracting mills and a seed plant, and contracts tens of thousands of smallholder farmers to produce cotton (China-Africa Cotton n.d.).

1. As of 2011, Chinese-funded agricultural demonstration centres were built in Benin, Cameroon, Ethiopia, Liberia, Mozambique, Democratic Republic of Congo, Rwanda, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe, as well as 11 rice production demonstration areas in Guinea-Bissau (Sun 2011).



Increasingly, large cotton companies have or are buying ginneries in Africa, which link farmers, merchants and textile mills, including to large players like Olam and Louis Dreyfus.

Ginneries extract the maximum value from cotton crops and are in total control over cotton production. Ghana, as part of its Cotton Revival Strategy, placed control over input supply and cotton production, purchasing and marketing in the hands of just three companies, and when two of them pulled out, the cotton sector fell into disarray (Essabra-Mensah 2016). In Malawi in 2016, when seven of the eight ginners in the country refused to provide inputs to farmers on credit, as farmers were unable to repay loans from the previous season, the result was very low production in the 2016/17 season (MWNation 2016). In South Africa's Makhathini Flats, farmers obtained credit from one state-backed ginnery, and, to avoid paying back the loans, sold their cotton to a competitor (Morse 2009). The state-backed ginnery collapsed, the competitor ginnery does not provide credit, farmers still owe more than \$3 million in debt, and many cannot afford to pay cash for inputs; all of which has led to a radical decline in production (Grain 2005). In Zambia, farmers tend to be completely reliant on pre-financing of inputs by ginners (Zambia Index n.d.).

Despite yield being a characteristic of plant breeding and not genetic engineering (the inclusion of a genetic trait designed to kill pests or withstand herbicide), the narrative underpinning the GM push in East and Southern Africa is about GM crops increasing yields. Such a narrative ignores the primary drivers of low productivity in Africa; chief among these being the volatility of cotton prices on the global market and the extent of subsidisation of cotton farmers in the US, China and the European Union (EU). As a Malian farmer noted at GM public consultations in that country, 'What is the point of encouraging us to increase yields with GMOs [genetically modified organisms] when we can't get a decent price for what we already produce?' (Pambazuka 2017). The experience in Burkina Faso provides another dimension to this argument. While farmers were happy with increased yields

(brought about by the characteristics in the conventional seed, into which the GM trait was introduced) because they received a guaranteed price, ginneries and merchants were less happy because they received prices determined by the quality of the fibre, which the Bt cotton did not deliver (Jishnu 2017).

The GM cotton push in Africa does not confront the issue of subsidies to cotton farmers in the US, China and the EU. GM cotton production will not confer on African farmers the necessary knowledge and bargaining power to participate genuinely in discussions with governments and ginneries around setting in-country prices for cotton. Undoubtedly, farmers will need to incur further debt to purchase expensive GM seeds on credit. It also places those using alternative systems, such as organic cotton production, at risk. The more than 25 500 smallholder farmers producing organic cotton in Africa can realise average yields of 1 780 kg/ha. They, along with organic producers in other countries, note the increasing difficulty in sourcing organic seed cotton, especially in countries that have adopted GM cotton.

Key findings

- Cotton is produced in more than 80 countries around the world, mostly by smallholder farmers. **Cotton production is dependent on cotton prices.** Production is expected to increase in the 2017/18 season, by 3% in China because of new subsidies and 6% in India because of a higher minimum support price and direct subsidisation and insurance guarantees in the US. Global **market prices are distorted by cotton producer subsidies** in the US, EU and China. The value of these subsidies in 2013/14 was a staggering \$6.5 billion.
- **More than 2 million African smallholder farmers produce cotton as a cash crop** in rotation with food crops, such as maize. The provision of cotton seed to smallholder farmers in Africa is viewed by many countries as a food security measure because it enables farmers in arid and semi-arid areas to generate a cash income with which to buy food. **Significant African cotton-producing countries are Burkina**



Faso, Mali, Cote d'Ivoire, Cameroon, Benin, Chad, Togo, Senegal, Egypt, Zimbabwe and Nigeria. Burkina Faso dominates production and export in the region.

- Africa's **average cotton yields are half the global average, at about 371 kg/ha.** This is ascribed by the industry to poor quality seed, lack of extension support and inability to access credit to buy fertilisers, among other determinants. **South Africa has the highest average yields of 2 383 kg/ha in 2016/17 and Mozambique the lowest, at 230 kg/ha.** Cotton is mainly produced by commercial farmers in South Africa. Organic producers in Benin, Burkina Faso, Mali, Senegal, Tanzania and Uganda are achieving average yields of 1 789 kg/ha.
- The primary **cause for falling levels of cotton production in Africa is the low prices** that farmers receive on the global market. This is evidenced in Kenya, Malawi, Tanzania and South Africa. The volatility of pricing, often driven by overproduction in major cotton-producing countries that subsidise production, compounds the challenges posed by rising input prices. African countries **do not seem to be able to take advantage of the 18–35% duty advantage** they have over other continents

because of a lack of institutional support and effort to provide appropriate solutions to cotton farmers.

- **Thirteen African countries either planted, undertook field trials or granted approval for the commercial cultivation of GM crops in 2016.** In East and Southern Africa, only South Africa and Sudan cultivate GM cotton commercially. Ethiopia, Malawi and Kenya plan to release GM cotton varieties commercially in 2018/19. Uganda is currently conducting confined field trials for GM cotton and Kenya has started open field trials, as has Malawi. Zambia intends to relax its strict liability clause in its Biosafety Act to start field trials and Swaziland started trials even before its regulatory framework was fully in place.
- **The Bayer-Monsanto merger is unlikely to shift the GM seed landscape** in Africa, given Bayer's limited presence in the Bt cotton seed market, except in South Africa and Cameroon (Maritz 2014). The ChemChina-Syngenta merger could, however, significantly grow Syngenta's market share, given China's deepening involvement in Africa's agricultural space (financial aid, demonstration centres, state-funded cotton companies) and



its stated desire to grow GM crops on a massive scale.

- Of the East and Southern African countries, **only Kenya, Malawi and South Africa are using or trialling Monsanto's Bollgard II technology**. Swaziland is using Indian GM varieties, Sudan is using a Chinese GM variety and Ethiopia prefers to draw on seed from India and Sudan, rather than using Monsanto's Bt cotton, because the company did not want to undertake laboratory or field tests (Kifle 2016).
- There is a **rise in secondary pest populations in countries that have adopted Bt cotton**, as seen in India, China, Burkina Faso and South Africa. This necessitates increased pesticide spraying, negating the objective of Bt technology. A Chinese study found that, even with stacked traits, resistance to Bt cotton is evident.
- **Advocates for GM adoption in Africa note obstacles** as being: the lack of science-based regulatory systems, strict adherence to the precautionary principle and liability provisions, labelling requirements, concerns about saving and exchanging seeds, fear of consuming GM foods, opposition from anti-GM organisations, and the emphasis placed on field testing prior to commercial release and on including socioeconomic considerations into approvals being granted.
- The **African Growth and Opportunity Act (AGOA)**, which, since 2000 has incentivised African governments to revitalise cotton production through a variety of mechanisms, serves the interests of US cotton farmers to a larger degree. AGOA excludes the import of raw cotton from Africa, but is beneficial to US farmers, as they can export their raw cotton for processing and manufacturing to a lower-wage country that then exports the processed product back to the US. Some US merchants have ginning operations in Africa, including Olam and Louis Dreyfus.
- There is **limited ability to contain unregulated transboundary movement of GMOs in Africa**. In Ghana, farmers smuggled Bt cotton seed from Burkina Faso and planted these without regulatory oversight (Food Sovereignty Ghana 2015). Even South Africa, with a world-class regulatory system, does not practise good governance in this regard.
- There is an **assumption that GM crop adoption is scale-neutral** and will benefit all types of producers across all regions and conditions in the same way. This is disproved through a 2006 study of Bt cotton farmers in South Africa that found significant disparities in yields and thus incomes (Dowd-Urbe & Bingen 2011).
- There is **no clear barrier between fibre, feed and food in cotton production**. It is not possible to contain the potentially harmful effects of GM adoption to fibres. Its adoption also ensures GM trait entry into the food products containing cotton seed oil.
- There is a **lack of participatory consultation with stakeholders** in some African countries regarding the adoption of GM technologies. This is true for Ghana, Malawi and Swaziland. In September 2017, 17 civil society groups in Nigeria sued the National Biosafety Management Agency for granting Monsanto a permit to release GM cotton in the country; they claim a lack of public engagement, noting that the permits were issued on a public holiday, which is illegal, and that they not conduct the necessary public hearings (Uwaegbulam 2017).
- The **refugia requirements** are not appropriate for African smallholder farming systems. They can often not afford to put land out of production or are not made aware of the need to do so to delay the onset of pest resistance. In addition, a recent Indian study found that GM seed companies were routinely flouting the regulatory requirement to provide non-GM seed for refugia planting and what was provided was contaminated with Bt cotton seed.
- The **high cost of Bt cotton seeds, when not subsidised, pulls farmers further into debt**. Above the cost of the seed, farmers also pay a technology cost per hectare. Given that there is no clear link between the GM seed companies and country-level ginneries, it is assumed that prices for GM cotton seed will be determined in each country and sold onto ginneries that will supply farmers on credit.
- While Bt cotton might generate higher yields in the short term, it **could also jeopardise fibre quality**, which equates to lower prices, as seen in Burkina Faso.
- While Bt cotton production shows

promising economic benefits in the short term, there **is no proven sustained impact**: due to the lack of standardisation of measures across trials, the findings from field trials cannot be transferred to farmers' fields, and there is no reliable measuring of purported socioeconomic benefits.

- More than 25 500 smallholder farmers in Africa produce organic cotton with average yields of 1 780 kg/ha. Organic producers in many countries note the **increasing difficulty of finding organic seed**, especially in countries that have adopted GM cotton.

GM cotton-growing countries in East and Southern Africa

More than two million smallholder farmers grow cotton in Africa (ACB 2015a). Planted in conjunction with food crops, such as maize (CmiA n.d.), cotton provides a vital source of cash income for rural communities. While production has slumped since the 1960s and African cotton farmers generate about half the global average yield at 371 kg/ha (USDa 2017), in South Africa – where cotton is produced mostly by commercial farmers – farmers generate average yields of 2 383 kg/ha (2016/17) and in Benin, Burkina Faso, Mali, Senegal, Tanzania and Uganda organic producers achieve average yields of 1 789 kg/ha. Many farmers have abandoned the crop because they operate in liberalised markets that provide little systemic support and sell onto a volatile global market, where subsidised farmers have a preferential advantage.

The cotton sector is viewed by many African governments, including those of Ghana, Kenya, Mozambique, South Africa and Tanzania, as key to supporting economic growth because of the sector's up- and downstream multiplier effect and its ability to absorb labour. Many cotton sectoral strategies have been produced to revitalise the sector. For many African countries, the opportunities provided through AGOA, which allows quota and duty-free access for cotton cloth to the US market, act as an incentive for governments to focus on the cotton sector.

As part of this drive, increasing attention has been paid to paving the way for GM cotton production, with claims that the increased yields accredited to this technology will solve seemingly intractable challenges of food insecurity and poverty in African countries.

In many cases, prompted and supported by US foreign agencies, particularly USAID, and private philanthropic organisations, such as the Gates Foundation that has funded several agricultural forums on the continent, African governments are shaping and re-shaping their biosafety regulatory frameworks and intellectual property rights regimes.

GM cotton production in East and Southern Africa

- South Africa started producing GM cotton in 1997 (Afribio n.d.).
- Zimbabwe conducted confined biotech cotton field trials in 2000, but abandoned this in 2005 (Ezezika et al. 2012).
- Uganda is conducting confined field trials for GM cotton (NEPAD-ABNE 2017).
- Kenya's National Biosafety Authority, in defiance of an order by the health minister, granted approval for GM cotton open field trials in August 2017 (Andae 2017) with commercial release expected in 2019 (Kenya News Agency 2017).
- Malawi is conducting open field trials at nine sites throughout the country, with commercialisation expected by 2019 (Chaweza 2017).
- Zambia is in the process of relaxing the strict liability clause in its Biosafety Act to enable it to start experimenting with GM cotton (ACB 2017).
- Swaziland started field trials for GM cotton prior to having a regulatory framework in place; commercialisation of three varieties is expected as soon as its Biosafety Act is amended (Observer 2017).
- Sudan has been producing Bt cotton commercially since the end of 2012.
- Ethiopia is planning for commercial release of Bt cotton in 2018.



Cotton: The world's most important fibre crop

Cotton is one of the most significant fibre crops in terms of land area used, after wheat, rice, maize and soybeans. It is grown on 2.5% of the world's arable land (ACB 2017) on about 32.4 million hectares in more than 80 countries (USDoA 2017). More than a quarter billion people generate an income from cotton production. Mostly smallholder farmers produce more than 20 million tons of cotton a year. Cotton production is projected to grow by 8% to reach 24.9 million tons by 2018 (USDoA 2017). This growth is driven by increased plantings, due to expanded consumption in import-orientated countries, such as Vietnam, Bangladesh and China (USDoA 2017).

Cotton has been cultivated for about 5 000 years and production until the 1950s was generally chemical free, with farmers managing pests and weeds through traditional methods, such as crop rotation (EJF 2007). A dramatic shift in agricultural production occurred after World War II. The industrial by-products of war, including chemicals, such as DDT, were marketed to the agricultural industry in the form of fertilisers, insecticides and herbicides. This chemical-intensive form of farming was accompanied by the advent of hybrid seeds, which produced higher yields if planted and produced using synthetic inputs and irrigation. A system of complementary seed and fertilisers/insecticides/herbicides was created. The delivery of this style of production was packaged as the Green Revolution, with the goal of dramatically increasing yields in response to global hunger and poverty levels in the developing world. To a certain degree, in Asia and Latin America in the early years, it did deliver on high yields, but at an environmental and social cost. The appeal for farmers was the diminished need for labour. This system has been promoted throughout Africa with the aim of increasing yields and delivering rural farmers from poverty through sales of the expected surplus.² It has not delivered on that promise.

The cotton production process

Seed cotton is mainly cultivated for its lint, which is used to make cloth; almost half of all textiles are made from cotton (WWF n.d.). However, up to 60% of the harvested crop is cotton seed (by weight) (ICAC n.d.). This is processed to make edible oil used in a range of food stuffs and industrial products, with the residue used for animal feed (ACB 2017).

Global and regional overview of the cotton market

About 80% of the world's cotton is grown in India, the US, China and Pakistan (USDoA 2017). India, China and the US are projected to be the biggest producers in 2017/18, accounting for 62% of global production; India at 25%, China at about 19% and the US at 18% (USDoA 2017). China and India are the biggest millers, accounting for 53% of all cotton produced (USDoA 2017), with Pakistan accounting for 9%. The US was the leading exporter of cotton in 2016; almost 80% of its cotton is processed abroad (ICAC n.d.). These exports contribute significantly to reducing the country's trade deficit (NCCoA n.d.).

Africa has a long history of cotton production. Prior to colonisation, production fed into strong domestic and regional markets, but during colonisation and from the 1960s onwards the sector was oriented towards the export markets (ACB 2004). Production increased significantly between 1991 and 1998 – by 175% – and by 2002, Africa grew 10% of the world's cotton and contributed 18% to global trade (ACB 2004). By 2017, cotton grown in Africa contributes only about 6% to global supply, 4% of that from 10 countries in West and Central Africa (Tovignon 2017). Over the past 25 years, African cotton producers have accounted for 1% of global mill use and 1% of global consumption (Republic of Tanzania 2016). Significant producers are Burkina Faso, Mali, Cote d'Ivoire, Cameroon, Benin, Chad, Togo, Senegal, Egypt, Zimbabwe and Nigeria (USDoA 2017). Burkina Faso dominates

2. See ACB's 2015 *A Green Revolution for Africa: A disaster in the making* for a more in-depth analysis of the Green Revolution in Africa.

The cotton production process

- **Farmers harvest seed cotton:** Farmers take the seed cotton to ginneries. Seed cotton comprises about 40% lint and 60% cotton seed (by weight) (ICAC n.d.).
- **Ginneries separate the seed cotton into lint and seed:** The seed cotton is dried and cleaned of foreign matter and pulled through a saw to remove the seed. The lint is then compressed into bales. A modernised ginnery can process about 60 bales an hour (NCCoA n.d.). The cotton seed undergoes further treatment at a cotton seed crushing mill, which can be on-site at the ginnery. The seed is put through a milling and delinting process to remove any remaining short fibres, which are used for mattress stuffing, among other products. The hulls are separated from the kernels, which are sold on for livestock feed and other industrial uses (NCCoA n.d.). The kernels are processed for their oil, which is used for cooking or in salad oil products, shortening, margarine, soaps, pharmaceuticals and cosmetics (NCCoA n.d.). The remaining meat of the kernel is converted into meal that is used in animal feed or as a natural fertiliser (NCCoA n.d.).
- **Ginneries sell the cotton and by-products into relevant markets:** Less than 1% of the 50 million tons of cotton seed produced each year is retained for future planting. Cotton seed is mostly processed into oil or used as animal feed and the lint is sold commercially in bales to textile mills or cotton merchants (NCCoA n.d.).
- **Textile mills and cotton merchants:** Cotton merchants buy cotton from farmers and sell to the mills (Ruh 2005). There is a futures trading market in cotton; cotton merchants can be divided into international merchants, regional merchants that focus on selected regions, local merchants operating within one country or region, and free on board (FOB) merchants that usually work on commission (Ruh 2005).
- **Retail and branded marketing and manufacturing sectors:** Most of the value accrues to this section of the value chain (ACB 2004).

production and export in the region (1.2 million metric tons in 2015/16), followed by Mali and Cote d'Ivoire (Mordor Intelligence 2017).

Cotton is grown on about 3.3 million hectares of land in Africa, yielding an average 371 kg/ha, less than half the global average (USDa 2017); some estimations show average yields as low as 240 kg/ha (Republic of Tanzania 2016). The low yields are commonly ascribed to the following (Republic of Tanzania 2016):

- Cotton is planted as a secondary crop and planting allocations are influenced by previous prices and the prices obtainable for food crops.
- Soil fertility is poor and the price of fertiliser is not viable.
- Weeding, spraying and harvesting relies on manual fieldwork.
- The price of inputs is high and production costs are rising; and farmers are unable to gain access to finance.
- Farmers do not have sufficient quality seed and extension services.

African productivity is declining at a time when productivity elsewhere is growing (ACB 2015a). The decline in cotton production mirrors a slump in production capacity, including manufacturing, on the continent. African countries contributed about 9% of the developing world's manufacturing output in 1990; this dropped to only 4% by 2014 (Economist 2017). Labour-intensive industries looking for locations with lower wage structures have tended to shift to Asian countries because of Africa's reputation for poor governance, political instability and lack of quality infrastructure (Economist 2017).

While its production has decreased, cotton still ranks second in value to cocoa exports from the region (Chitah 2016). About two million rural households in 28 African countries (ACB 2015a) are dependent on cotton production in sub-Saharan Africa; the profitability of the sector therefore has a widespread and significant impact on rural livelihoods (Chitah 2016). Cotton is a dryland crop and provides farmers with a source of cash income in areas with little access to irrigation (ACB 2017), where it is generally grown in rotation with basic food crops, such





as maize, soybean and groundnuts (CmiA n.d.).

The long-term effects of liberalisation of market economies in Africa are visible in the cotton sector, where there are low levels of investment in appropriate research and development, and weak extension services and infrastructure, including post-harvest storage capacities.

African farmers operate in a tough competitive environment, with little appropriate institutional support and in a global market in which prices are distorted by unfair subsidies in the US, the EU and China (ACB 2015a). The odds seem stacked against African cotton farmers, despite their having an 18–35% duty advantage over other continents (Economist 2017), through duty-free access to some international markets.

Control of the global market

Cotton is a global commodity with prices set on the international market. The cotton trading market has consolidated since the

end of World War II, with multi-commodity US-based trading merchants dominating (Ruh 2005). Post-2008, the global credit crisis and economic recession resulted in an extremely volatile cotton futures market and a series of bankruptcies and mergers, as well as the entry of new players, mostly multi-commodity traders (ICAC 2009). Major players, such as Albrecht, Mueller-Pearse & Co., Paul Reinhart America, Dunavant Enterprises and Weil Brothers Cotton exited the industry (ICAC 2009). By the end of 2009, 13 companies controlled 26% of global cotton trade, with 9% of them controlling 22% (ICAC 2009).

By 2014, the top 10 cotton traders (those dealing with annual volumes of more than 200 000 tons, were Louis Dreyfus Commodities, Cargill Cotton, Olam International, Ecom USA, China Tex, Paul Reinhart Switzerland, Toyo Cotton, Plexus Cotton, Ministry for Foreign Economic Relations Investment and Trade (Uzbekistan) (MFERIT) and the Staple Cotton Cooperative Association (Staritz & Troster 2015). Only MFERIT (government-owned) and the Staple

Cotton Cooperative Association are not active in sub-Saharan Africa, and, along with United Kingdom-based Plexus, are not multi-commodity traders (Staritz & Troster 2015).

Louis Dreyfus operates in China, Latin America, West Africa, India, Pakistan, Australia and the US, where it has storage, merchandising, marketing and logistics operations. Its African operations are run out of Cape Town, South Africa and it is a major shareholder in NWK Agri-services' Zambian ginnery, the biggest in the country. It sold its Africa-based fertiliser and inputs operations to Helios Investment Partners in 2017 (Louis Dreyfus 2017). The Olam Group has a network of more than 10 000 farmers, ginneries and suppliers and it operates ginneries in six African countries (Olam Group n.d.).

The cotton market comprises a tight chain from production to retail of finished products, with most profit accruing to cotton merchants and retailers. The merchants' profitability accrues in the margins made per bale of cotton (Ruh 2005). Leading merchants typically have warehousing and ginning operations (Ruh 2005), supplying credit and inputs to farmers, thus maximising their margins from the production stage onwards, and generating additional income through the sale of oils and feed. Their capital stocks of warehousing and distribution channels enable them to hold cotton stocks and deliver on demand to individual processors (ACB 2004).

The GM cotton seed market in Africa

The Bayer-Monsanto merger was approved in South Africa in May 2017, resulting in a monopoly in the supply of GM cotton seed in the country, where more than 90% of seed used is genetically modified. South Africa's Competition Commission approved the Bayer-Monsanto merger, with some conditions (Competition Commission 2017). Both companies are active in the input industry in South Africa, and both are heavily involved in research and development for genetically engineered traits (Competition Commission 2017). The commission's concerns about the merger centred on the competition aspects in the GM cotton

market, as it would remove the opportunity for Bayer to independently enter South Africa to compete against Monsanto, particularly in the development and production of traits for seeds and accompanying herbicides (Competition Commission 2017). The industry also has structural characteristics conducive for coordinated conduct because of cross-licensing agreements (Competition Commission 2017). Conditions include that the merged entity divest and sell Bayer's entire global Liberty Link trait technology and associated branded agrochemicals (Competition Commission 2017). A further condition is that the buyer needs to commercialise the divested products in South Africa or license the business to a South African third party to license anywhere in the world, should the purchaser be unable to do so (Competition Commission 2017). The merger was also approved by the Common Market for Eastern and Southern Africa's (COMESA) Competition Commission in September 2016, but with no stipulated conditions (COMESA Competition Commission 2017).³

Monsanto dominates sales of GM cotton on the continent. Bayer has representative offices in Ghana, Zambia and Angola with key markets for its crop protection products being South Africa, Kenya, Cote d'Ivoire, Morocco and Algeria (Bayer 2017). In 2012, Bayer decided to grow its seed business in Africa, with a focus on cotton and rice (Maritz 2014). Bayer's GM cotton seeds were sold in South Africa in 2013 and it has started cotton trials in Cameroon, with commercialisation expected in 2018 (Maritz 2014). Bayer, however, with a SeedGrowth centre only in South Africa (Bayer 2016), notes that the limited size of individual country markets and cross-border trading challenges make it unfeasible to open other such plants on the continent (Maritz 2014).

The merged company will enjoy Monsanto's existing presence in African countries and the ability to perhaps provide further complementary products, without the risks posed to Bayer in entering these markets. It is not clear whether the sale of Bayer's Liberty brand will impact significantly on revenue.

3. For more information on the likely effects of this merger, see ACB's *The three agricultural input mega-mergers: Grim reapers of South Africa's food and farming systems* (2017).



Although Bayer was asked to enter Burkina Faso to develop a more suitable Bt cotton, following the failure of Monsanto to deliver quality, long-fibre cotton, the government there is also open to allowing Monsanto re-entry if it can fix the problem (see box, 'BT cotton in Burkina Faso: A dismal failure', below) (Mueller 2016). Either way, the merged company would reap the benefits. The merger does, however, remove the potentially strong competition that Bayer would have offered on entry to these markets, which could have lowered the cost of GM seeds.

Perhaps a more interesting turn of events is the impact that the ChemChina merger with Syngenta will bring about. Syngenta has a significant presence in the cotton markets of West Africa, particularly Cameroon and Cote d'Ivoire (Gabas 2016). China is already producing generic GM seeds at a much lower cost, and is actively increasing its participation in the African agricultural space. China has stated its intention to plant GM crops on a very large scale; this is one of the motivations for the acquisition of Syngenta (DW 2016). Only two GM crops are currently authorised in China, a cotton variety approved in 1996 and a virus-resistant papaya approved in 2006 (DW 2016). It is, however, a major consumer of GM crops (DW 2016). See partnerships section for more on Chinese engagement in African agriculture.

Past mergers and acquisitions also helped boost the market position of Monsanto and Syngenta. French Seed Groupe Limagrain bought a 28% stake in Seed.Co, which sold 49% of shares in its cotton seed company Quton (Africa's only cotton seed company) to Mahyco of India (ACB 2014). Monsanto owns 26% of Mahyco (ACB 2014). In 2013 Syngenta took over MRI Seed in Zambia, which owned among the biggest and most diverse collection of maize germplasm in Africa (ACB 2014).

Cotton subsidies in the US

The US subsidisation of cotton production has been a controversial topic for decades. Up until 2005, cotton farmers were receiving more than half their revenue from government subsidies for crop insurance, production and export purposes (US News 2016). This has been extensively criticised

for its distortion of global markets and the lowering of producer incomes in other countries (US News 2016).

In 2005, Brazil won its dispute with the US at the World Trade Organization over the extent to which US subsidies had depressed world cotton prices through overproduction; Brazil was compensated with a \$750 million pay-out and the US promised to revise its Farm Bill in 2014 (US News 2016). Some moderations were made, but the cotton industry is lobbying for expansion of subsidised support for farmers. In 2016, the US government announced that cotton producers would receive once-off payments totalling \$300 million under the Cotton Ginning Cost Share Program; this is 60% more than what farmers received through the Cotton Transition Assistance Program, which was meant to help farmers transition from direct subsidy payments (ICTSD 2016). They also benefit from a Stacked Income Protection Plan (ICTSD 2016), market assistance loans and crop insurance coverage; these new insurance-based subsidies continue to stimulate US production and exports and suppress global cotton prices by at least 6% (US News 2016). Brazil notes that these subsidies are just a new form of distortionary tactic. Benin, Burkina Faso, Chad and Mali have repeatedly called for restrictions on the levels of trade-distorting, domestic support provided in the US (ICTSD 2016). Just the US cotton insurance subsidies cost the government about \$400 million in 2015/16 (ICAC 2016).

Subsidies in China and India

China controls the volume and value of imports, applying sliding scale tariffs on imports, and it releases its stockpiled cotton onto the market when there is a shortage, to support price stability (ICAC 2016). Its release of cotton stocks onto the domestic market in 2017 has galvanised local milling and textile production due to the availability of cheaper domestic product (ICAC 2017). It also provides direct subsidies to cotton growers. Total direct and indirect subsidisation and border protection measures amounted to \$5.3 billion in 2015/16 (ICAC 2016). The Chinese government also pays producers a subsidy to use high-quality planting seeds, at a cost of about \$150 million a year (ICAC 2016).

India provides a minimum support price and the government purchases cotton directly from farmers when market prices fall below this threshold (ICAC 2016). It also provides its farmers with debt forgiveness mechanisms and fertiliser subsidies and crop insurance, as well as making funds available to modernise ginneries and pressing units (ICAC 2016). The amount of direct subsidisation in 2015/16 is estimated at \$50 million (ICAC 2016).

Subsidies in the EU

Cotton farmers in the EU receive a single payment as an income aid and production aid per hectare planted (ICAC 2016). Farmers in Greece and Spain, significant cotton-producing countries in the EU, received about \$224 million and \$68 million respectively in direct subsidies in 2015/16 (ICAC 2016).

Subsidies in West Africa

Mali provided subsidies for cotton inputs amounting to \$26 million in 2015/16; Burkina Faso paid \$30 million, Cote d'Ivoire \$14 million and Senegal \$2 million in 2015/16 (ICAC 2016), primarily for minimum price support, and not for production itself. In other African countries, farmers may be putting some of the fertilisers provided for maize through state-funded fertiliser input subsidies towards cotton crops; but not receiving direct support for cotton production.⁴

The gene revolution: A disaster in the making

Genetic modification of seed cotton is the inclusion of gene traits from other species into the cotton DNA to enable the resultant plant to either kill off its primary pest or be resistant to the associated herbicide. There are currently two types of GM cotton seed on the market. The most common is Bt cotton, which is genetically engineered to produce a toxin that kills one of cotton's primary pests, the bollworm (CBAN 2013). *Bacillus thuringiensis* (Bt) is soil bacteria that has been used as a natural insecticide for almost a century (Niederhuber 2015). Isolated crystal proteins (Cry proteins) from Bt DNA are inserted into the genetic structure of cotton; this results in the plant continually producing Bt toxins (Niederhuber 2015). The

goal is to reduce losses and thereby increase productivity.

The second GM cotton seed is resistant to glyphosate-based herbicides, such as Monsanto's Roundup and Bayer's Liberty brands. The goal is to easily eliminate weeds that are not resistant to the herbicide, thereby saving on labour costs. Glyphosate is a broad-spectrum herbicide that affects nearly all plants (Wilkerson 2015). The gene providing the plants with resistance to glyphosate is taken from the *Agrobacterium* genus (Wilkerson 2015). Ongoing research into GM technology for the cotton plant is focused on conferring drought-related traits, improving fibre quality (using genes from spinach, spider's silk and silk worms) and enhancing the nutritional value of cotton seed (ICAC 2013).

The 1980 decision by the US Supreme Court in the Chakrabarty case to allow patents to be registered on genes provided an avenue for biotech companies to patent gene sequences. Biotech companies typically register utility patents, which require more detailed information regarding the genetic modification than plant patents, but extend to the new DNA (complementary cDNA) that results from the modification (Zhou 2015). The extension of patent protection to the cDNA enables biotech companies to use the genetic sequence in any other plant (for example, in cotton, soyabeans and maize) without having to re-register the patent. Utility patents are also more easily enforced and they prohibit the planting of seeds harvested from the licensed plant (Zhou 2015).

These patents allow biotech seed companies to not only sell their seeds, but also demand a technology fee for their use. Technology fees differ between countries and sometimes within regions (ICAC 2013). In South Africa, following farmer complaints, Monsanto moderated its technology fee from R600 a hectare to R400 a hectare for irrigated production and R120 for dryland production; still a substantial amount for a smallholder farmer (Gouse et al. 2003).

4. For more information on these programmes, see ACB's paper 2016 *Farm Input Subsidy Programmes (FISPs): A benefit for, or the betrayal of, SADC's small-scale farmers*.





Their application also precludes farmers from saving seeds from harvest for replanting the following season. Companies wanting to use the traits for developing their own products must pay the owner of the technology a fee. When multiple traits from different companies are used, these fees are prohibitive and either exclude those wanting to develop new plant traits or are passed onto the consumer in the cost of the seed.⁵

Monsanto was the first to gain a patent on Roundup Ready in 1996 (Zhou 2015) and it dominates the global market for Bt cotton (Morse 2009). It is the sole owner of the Bollgard technology (Bt cotton) (ICAC Recorder 2003) and gained approval for commercial use in the US in 1995, China in 1997, South Africa and Argentina in 1998 (ICAC 2013), India in 2002 (Morse 2009), Brazil in 2005, Costa Rica in 2008, Burkina Faso in 2009, Pakistan and Myanmar in 2010 and Sudan in 2011 (ICAC 2013).

How the biotech industry protects its interests

To accommodate for patent expiry, companies tend to absorb the first offering into a new and improved version, normally

with two traits, and more recently with three. This is illustrated in Monsanto's Bt cotton Bollgard I, II and III products. The patents underpinning Bollgard I expired in 2011 and 2014 (Zhou 2015). Indian and Chinese companies were quick to produce much cheaper generic versions of the technology. Monsanto had already presented its second-generation Bollgard II with the addition of a new Cry protein in 2003 (ICAC Recorder 2003). It can effectively charge for the genetic trait from Bollgard I plus the new trait. Bollgard II falls under a new patent, ostensibly conferring 'enhanced' pest resistance to combat the rise of secondary pest populations from use of Bollgard I. It also is marketed as extending the effectiveness of the technology to a broader spectrum of pests (ICAC Recorder 2003). Bollgard III uses three genetic traits to attack the target pest in different ways, thus delaying the development of resistance (Monsanto Global n.d.). The advent of stacked gene technology has enabled biotech seed companies to license their gene traits in combination with others to produce both herbicide and pest-resistant cotton products.

5. See ACB's 2010 *The GM stacked gene revolution: A biosafety nightmare* for an explanation of cross-licensing and stacking of traits.

To protect against patent infringement, biotech companies only enter countries that have the necessary legal and regulatory environments in place to protect their intellectual property, and a conducive biosafety framework. ICAC (2013) notes the obstacles to the adoption and trade in GM crops as being:

- Low levels of public acceptance; this determines the stringency of the regulatory systems and has led to divergent models emerging.
- Asynchronous approvals, where the biotech seed is approved in some countries, but not others, making trade difficult.
- Experiences in which shipments of seed are delayed or rejected because of a low level of contamination.

In India, Monsanto through its joint venture with Mayco Seeds Ltd. licenses its patented Bollgard II cotton seed technology to 49 seed companies for a royalty fee; more than 90% of cotton grown in India uses this technology (Bera & Sen 2016). Monsanto has recently pulled out of India because of the government's decision to cap the cost of Bollgard II seeds, radically reducing the technology fee payable by 74% (Byayani 2017). BASF also closed its biotechnology research portfolio in India in 2016 and Bayer CropScience followed Monsanto's example, claiming that it could not operate in a country without 'a conducive policy environment, strong government support and reliable protection of intellectual property rights' (Byayani 2017). It is estimated that Monsanto generated about \$668 million (Rs. 4.479 crore) in royalty fees between 2005 and 2015 (Bera & Sen 2016), above the money made on sale of seed and complementary products.

The GM cotton push in Africa

Facilitators and beneficiaries

At a 2014 conference, a Syngenta representative noted the obstacles to GM adoption in Africa as the lack of science-based regulatory systems, strict adherence

to the precautionary principle and liability conditions, labelling requirements, concerns about saving and exchanging seeds, fear of consuming GM foods, opposition from anti-GM organisations and the emphasis placed on field testing prior to commercial release (De Ronde 2014). The precautionary principle states that 'when an action (e.g. release of a genetically modified organism) is suspected to pose a threat to health or environment, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat' (Adenle et al. 2013). There are 46 countries that are signatories to the Cartagena Protocol on Biosafety, which mandates public consultation prior to adoption (De Ronde 2014). Except in South Africa, Burkina Faso and Sudan, commercial adoption of GM technologies has, until recently, been stalled in Africa.

A regulatory regime that is acceptable to private sector parties is key to the introduction and commercialisation of GMOs, and the introduction of favourable biosafety laws is the first step (Ezezika et al. 2012). GM seed companies need a biosafety and intellectual property framework that enables them to protect their patents and resultant royalties and does not confer strict liability on them if anything goes wrong. Tanzania's strict liability regulation is a case in point; Monsanto transferred its field trials of Bt cotton to Kenya when efforts to revise biosafety laws lagged (Ezezika et al. 2012).

Private and public actors act concertedly to promote the use of GM crops on the continent, diverting significant levels of funds to this end. An overview of significant actors and their partnerships is provided below.

At the regional level

African Union members adopted a 20-year biotech strategy in 2007, although there has been little implementation since then (Adenle et al. 2013). More focused activity takes place within the regional economic communities: COMESA and the Economic Community for West African States (ECOWAS) are readying their members – 34 African countries – for the commercialisation of GM cotton through harmonised biosafety policies (ACB 2015a).



The COMESA Treaty (chapter 19, articles 129–137) stipulates full cooperation in agricultural development, science and technology domains, including harmonisation of agricultural policies (Tembo 2017). COMESA has promoted biotech activities in member states in collaboration with the USDaA, the ISAAA in Kenya and the South Asia Biotechnology Centre (Koigi 2016). In 2014, COMESA approved a regional policy on biotechnology and biosafety that provided a mechanism for scientific regional risk assessment of GMOs for commercial planting (AfricaCentre 2014). COMESA's specialised agency, Alliance for Commodity Trade in Eastern and Southern Africa (ACTESA) is spearheading the implementation of its biotechnology and biosafety programme (Nkambule 2017).

In 2015, COMESA developed a seed trade harmonisation regulations programme to promote implementation of harmonisation plans, and ACTESA works to align national seed laws to the harmonisation regulations (COMESA 2017). ACTESA is operationalising the COMESA Variety Catalogue that will market seed in 19 member countries (COMESA 2017). Notably, by April 2017, only 17 varieties had been registered from just five companies: Pannar, Monsanto, HZP Holland, MRI/Syngenta and Pioneer Dupont (COMESA 2017).

Also in 2015, COMESA validated the implementation plan of its policy on biotechnology and biosafety, which aims to help member states build the necessary institutions and regulatory frameworks for use of biotechnology (ISAAA 2015). The plan's stated goal is 'to support the member states to realize their aspirations of becoming active participants on the global biotechnology enterprise through commercial planting of GM crops, trade in products of GM technology and involvement in dealings with emergency food aid with GM content' (ISAAA 2015).

In late 2016, COMESA funded a delegation from Ethiopia, Kenya, Malawi, Swaziland and Zambia to visit India, on a 'seeing is believing' tour of Bt cotton production in the country (Cerier 2017). It funds regular educational workshops for journalists in countries such as Zimbabwe (Tsiko 2017) and hosts, in

partnership with others, risk analysis and regulatory compliance workshops on GMOs to build national-level capacity (NEPAD 2017).

In 2016, several national regulatory agencies formed the Association of National Biosafety Agencies in Africa (ANBAA), which aims to facilitate the sharing of data between countries (ISAAA 2016).

Public funds

Public funds are channelled into facilitating the entry of GMOs into African countries. The Kenyan government funds GMO research at its Agricultural Research Institute and the Ugandan government, in partnership with donors, has developed biotechnology infrastructure (laboratories and greenhouses) and invested in skills development in this regard at the National Agricultural Research Organization (Okena et al. 2013). In East Africa, the USAID-funded Bt cotton project was initiated in 2006 by agbiotech experts from the US, with scientists from Tanzania, Kenya and Uganda to study the possibility of gene flow from Bt cotton to wild cotton varieties (Ezezika et al. 2012). Indeed, much of the work done by COMESA and ECOWAS is funded and influenced by USAID.

The Asian connection

There are increasing partnerships between Africa and Asia (India and China) to support adoption of GM technology through the sharing of technology and expertise (ISAAA 2016). Use of GM technology in Africa will also get a boost from China's decision to speed up the commercialisation of GM crops, such as maize and soybean (Cerier 2017). China is a major trading partner for many African nations and a major source of foreign direct investment and aid (Cerier 2017).

The China-Africa Cotton Development Limited has significant assets in African countries. This joint venture with the China-Africa Development Fund, among other partners, was established in 2009 with an investment portfolio of \$64 million (China-Africa Cotton n.d.). It has fully-owned subsidiaries in several African countries that focus on research, production, purchasing, processing and oil processing and textile manufacture (China-Africa Cotton n.d.). The company directly contracts about 200 000 farmers to produce cotton and currently

owns seven ginneries, two cotton seed oil extracting mills and a seed plant in Africa (China-Africa Cotton n.d.).

- In Malawi, it acquired the local American Cargill company and became the biggest cotton company in the country.
- In Zambia, it contracts 50 000 farmers and owns two ginneries and one oil mill.
- In Mozambique, it bought French cotton company C.N.A and is one of the three largest cotton planting and processing enterprises in the country.
- In Zimbabwe, it merged two local cotton companies to become the second largest cotton company in the country, and it has established two ginneries and contracts 70 000 farmers to grow cotton. There are also plans to establish a seed breeding operation and an oil mill in Zimbabwe.

In other African countries, such as Kenya, governments are looking to Chinese companies to invest in and support growth of the cotton sector (Morangi 2017).

Snapshots of biotech cotton production in East and Southern Africa

Table 1 focuses on Ethiopia, Kenya, Tanzania and Sudan in East Africa, and Malawi, Mozambique, South Africa, Tanzania and Zambia in Southern Africa. It does not cover Madagascar, which bans the import of GM products, and Zimbabwe, which stopped confined field trials for Bt cotton in 2005.

African governments and farmers would do well to look to the example of Burkina Faso (see box, 'BT cotton in Burkina Faso: A dismal failure') to learn about the implications of a rushed adoption of these technologies, proven to have negative consequences for agricultural systems. In addition, the experiences of small-scale farmers in South Africa's Makhathini Flats provide a cautionary lesson regarding expectations around tangible socioeconomic benefits (see 'Bt cotton and the Makhathini Flats: A cautionary tale').

Table 1: Regulations and status of biotech cotton production in East and Southern Africa

| Country | Regulations in place | Status of adoption | Expected commercialisation |
|----------|--|--|--|
| Ethiopia | Amended the Biosafety Proclamation (2015). ¹⁹ | Confined field trials of Bt cotton in several country locations 2016. ²⁰ | Commercialisation expected by 2018/19 and seed uptake aimed at large-scale commercial farmers. Bt cotton seed not sourced from Monsanto, possibly Chinese supplier. ^{21/22} |
| Kenya | Biotechnology Development Policy (2006); Biosafety Act (2009); Ban on importation of GMOs (2012); Ban on field trials in 2017, but ignored. ¹ | Confined field trials of Monsanto's Bollgard II concluded 2012. Approval granted for open field trials in 2016, but halted due to Health Minister's concerns. Open field trials started in August 2017. ² | Monsanto's Bollgard II is expected to be released in 2019. ³ |



| | | | |
|--------------|---|--|---|
| Tanzania | National Environment Act (2004), national biosafety legal framework (2007), National Biotechnology Act (2010), Biosafety Guidelines (2012). ¹⁵ | Confined field trials for WEMA GM maize 2016. ¹⁶ No cotton trials as yet. | |
| Sudan | National Biosafety Framework. ²³ | Field trials 2012. ²⁴ | Released for commercialisation 2012. Chinese Bt cotton variety. ²⁵ Adoption of biotech cotton at 98%. ²⁶ |
| Malawi | Biosafety Act (2002), National Competent Authority (2013). ⁴ | Variety registration trials in nine locations 2016. ⁵ | Monsanto's Bollgard II is expected to be released in 2019. ⁶ |
| Mozambique | Biosafety regulations (2007), Revised Biosafety Decree (2014). ⁷ | Confined field trials for GM maize in 2017; no cotton as yet. ⁸ | |
| South Africa | National Biotechnology Strategy (2011), National Biosafety Framework. ⁹ | Confined field trials for three new cotton varieties with stacked insect resistance and herbicide tolerant traits were approved in 2016. ¹⁰ | Commercialised in 1998. About 95% of cotton is grown using double-stacked, herbicide-tolerant, insect-resistant GM traits. |
| Zambia | National Biotechnology and Biosafety Policy, Biosafety Act (2007). ¹⁷ | In process of relaxing biosafety laws to allow for trials of Bt cotton. ¹⁸ | |
| Swaziland | National Biosafety Act (2012), currently under revision. ¹¹ | Field trials 2014, halted because of no import permit, recommenced in 2016. ¹² | Application for commercial release with the Cotton Board. ¹³ The variety is Bt cotton, owned by Indian JK Agri Genetics and in agreement with Mahyco Monsanto Biotech. ¹⁴ |

Sources: 1: Okena et al. 2013, 2: ACB 2015a/ Gebre 2017, 3: Kenya News Agency 2017, 4: NEPAD-ABNE 2017, 5: Chaweza 2017, 6: Chaweza 2017, 7: NEPAD-ABNE 2017, 8: NEPAD-ABNE 2017, 9: NEPAD-ABNE 2017, 10: Afridio n.d., 11: ACB 2017, 13: Observer 2017, 14: ACB 2017, 15: NEPAD-ABNE 2017, 6: NEPAD-ABNE 2017, 17: NEPAD-ABNE 2017, 18: ACB 2017, 19/20: Global Agricultural Information Network 2016, 21: Koigi 2016, 22: Capital Ethiopia 2016, 23/24/25: Abdallah 2014, 26: Zwane 2017.

Bt cotton and the Makhathini Flats: A cautionary tale

South Africa's smallholder cotton farmers are found mostly on the Makhathini Flats – in 2009, out of a potential 5 000 smallholders in the region about 1 400 were small-scale cotton farmers (Morse 2009), with a few (300) in the Tonga area (Gouse et al. 2003). Agriculture is the main source of income in the Makhathini Flats and farmers produce on small plots of land (1–3 hectares), which is granted to them by tribal chiefs (Morse 2009). Cotton is the favoured crop as it can be grown in conditions of low, irregular rainfall (Gouse et al. 2003). Farmers face constraints such as poor water availability – water often has to be carried up to 10 km – pest attacks and limited marketing options (Morse 2009).

Monsanto mounted an aggressive campaign in the late 1990s to introduce GM cotton to smallholders in the region (ACB 2015a) and by 2002 about 92% of farmers in the region had adopted Bt cotton. By 2004/5 this figure had increased to almost 100% (Morse 2009).

Makhathini Flats is not representative of smallholder farmer communities: it is a large development scheme with extension services (Grain 2005). The Bt cotton project was heavily subsidised and supported by national and provincial government (Grain 2005).

Farmers in the region operated in a closed value chain, sourcing credit and inputs from a single private ginnery, Vunisa Cotton, until 2002. Vunisa Cotton deducted what it was owed by farmers prior to paying them for their cotton (Morse 2009). In 2002, a new cotton ginnery, Noordelike Sentrale Katoen (NSK), moved in, with the capacity to gin ten times more cotton than was actually produced in the region (Morse 2009). Farmers chose to sell their cotton to the new ginnery to avoid paying back their loans to Vunisa Cotton (ACB 2015a). While farmers realised a benefit in one season, Vunisa Cotton closed, due to R22 million in unpaid debts (ACB 2015a), and NSK did not provide credit for farmers to purchase inputs for the following season (Morse 2009). As a result, poorer smallholders were unable to plant the following year. By 2006, only the wealthier and more efficient farmers grew Bt cotton (Dowd-Urbe & Bingen 2011) and by 2007/8 only about 700 farmers grew cotton in the region (Morse 2009). Many farmers were left destitute, with social relations in tatters (ACB 2015a).

While a study tracing the impacts of adoption up until 2005 found that Bt cotton did increase profits for resource-poor farmers, it found that these gains could only be sustained over relatively short periods (Morse 2009) and depended on factors not commonly found in African smallholder systems, such as the ability to farm at scale with access to capital and inputs. Biowatch's research work into the effects of Bt cotton adoption in this region note that adoption rates dropped dramatically after the first three years, with the total area planted to cotton also declining. In addition, a more detailed survey of profits generated from adoption of the crop indicate that only four farmers in the sample group of 36 had actually made a profit (Grain 2005). The Land Bank announced in 2004 that 2 390 farmers in the region still owed a total of just more than \$3 million (Grain 2005). About 80% of farmers defaulted on their loans (Grain 2005).

This cautionary tale highlights that adoption of any new technology is only likely to be successful when supporting structures are in place and issues of access, distribution and benefits have been addressed. The promotion of Bt cotton as a saviour crop is dangerous and can deepen existing challenges that smallholders face. Bt cotton cannot be expected to resolve the root causes of poverty (Morse 2009).



BT cotton in Burkina Faso: A dismal failure

Burkina Faso is one of Africa's poorest countries, but is a leading cotton producer recognised for its quality, long-fibre crop (Jishnu 2017). The crop contributes just more than 4% to GDP, accounts for 75% of export earnings and employs – directly and indirectly – about 25% of the working population (Jishnu 2017). Field trials for Bt cotton were implemented in 2003, apparently without due process being followed; a presidential decree was issued granting permission for the trials. The closed cotton value chain with one parastatal cotton company managing all aspects of production, including credit supply, seed production and distribution and extension support, made it easier for actual Bt cotton production to be approved in 2008 (ACB 2015a). Nearly 70% of land under cotton was planted to Bt cotton by 2012 (Indianexpress 2017). About 140 000 smallholders were cultivating Bt cotton by 2014, the largest number of total GM crop producers on the continent (Dowd-Urbe & Schnurr 2017).

Farmer-led research into production results from 202 cotton farmers (Vishnu 2017), however, indicated that, while farmers were paying up 30 times more for Bt cotton seeds, yields were 7% lower than conventional varieties (Indianexpress 2017). In 2015 government announced it would be reducing GM cotton production over three years and then shutting it down (ACB 2015a). Farmers have paid dearly for the experiment in GM cotton production. Their cotton crops were downgraded because the plants produced short fibres and, in many cases, they experienced low yields because of the need for precise fertiliser and pesticide application, which they had not been adequately trained to perform, and increased insect resistance (ACB 2015a). The country's leading cotton company SOFITEX, responsible for about 40% of national cotton seed production, discontinued one of the Bt seed varieties because of the short fibre problem (ACB 2015a). This issue was a result of inadequate backcrossing of the Bt gene with local varieties (Jishnu 2017). By 2014, levels of insect resistance to the Bt technology rose, possibly because farmers were unable to manage refugia in a way that minimised this threat (ACB 2015a). The contractual obligation to plant up to 20% of their fields to non-GM cotton, to provide a refuge for insects, is not practical for farmers with small acreage; they cannot afford to lose the revenue (ACB 2015a). The risk taken by farmers with the higher seed costs and uncertain global prices is compounded by the absence of a credible system to manage the development of insect resistance and farmers are at further risk of crop failure due to insect damage (ACB 2015a).

The Burkina Faso case highlights an interesting dimension to cotton production in any African country. While the Bt cotton seeds are promoted and adopted because of their supposed ability to yield higher amounts of cotton per plant and reduce the costs and time of pesticide spraying, higher yields do not necessarily translate into quality cotton, which is what is desired by cotton companies. While farmers received a set rate for their cotton, regardless of quality, the cotton companies derive their income from quality cotton.

Burkina Faso cotton companies' decision to not provide Bt cotton seeds ended GM cotton production in the country. The three major companies filed a suit against Monsanto, demanding €74 million (about \$76 million) in compensation for lost revenue (Indianexpress 2017). They settled on holding 75% of royalty fees that had been retained from Monsanto from the 2014/15 and 2015/16 harvests (Jishnu 2017). Burkina Faso is in the process of drafting an official position on biosafety and biotechnology and ABNE supports this process (NEPAD-ABNE 2017). A narrow, trait-specific approach to addressing agricultural development can have unintended and negative consequences (Dowd-Urbe & Schnurr 2017).

Ghana's GMO misstep

Monsanto's forced withdrawal from Burkina Faso (see box, 'BT cotton in Burkina Faso: A dismal failure') led to the company also withdrawing from Ghana, where the same variety of Bollgard II was being trialled. Ghana is now looking for alternative donor support to continue trials (Gakpo 2017).

Ghana produces about 4 000 metric tons of cotton a year, with ginning capacity of 70 000 metric tons (Essabra-Mensah 2016). As elsewhere in Africa, Ghanaian cotton farmers operate in a volatile pricing market. With the support of the World Bank, the country launched its Cotton Revival Strategy in 2010, which aimed to promote private investment in the sector (Essabra-Mensah 2016). The cotton-producing regions were divided into three zones, each assigned to a company: Wenco Ghana, Olam Ghana Limited and Plexus (Essabra-Mensah 2016). The three companies provided inputs (but needed to source seeds from outside the country), extension advice and tractor services (Scholtes et al. 2011). On delivery of the cotton seed, deductions were made for these inputs and services from payments to cotton farmers (Scholtes et al. 2011). However, in the 2012 to 2014 seasons two of the three companies pulled out of cotton production, because farmers were retaining seed and not handing in their full yield (Yakuba 2015). Only Wenco retained some production under its maize programme (National Biosafety Authority 2015). This has left the country's cotton sector in disarray.

Ghana passed its Biosafety Act in 2011 and has drafted revisions to the Act, which are waiting to be passed by Parliament (NEPAD-ABNE 2017). In 2015, the Board of the National Biosafety Authority was inaugurated and an appeals tribunal has been established (NEPAD-ABNE 2017). Trials on Bt cotton were initiated in Ghana in 2012 and meant to conclude in 2018 (Gakpo 2017). In 2017, Ghana suspended trials of Bt cotton, because Monsanto withdrew its funding, following its experience in Burkina Faso (Gakpo 2017).



Known adverse consequences of GM cotton

There is significant opposition to the adoption and cultivation of Bt cotton on the continent stemming from farmers, their representative organisations, scientists, research organisations and environmental and social justice groups. Their concerns are far reaching encompassing the likely socioeconomic effects on smallholder farming systems—based on experiences in South Africa, China, Latin America and India, the marginalisation of the most resource-poor producers, the further diversion of research and development funding from much-needed support systems and the known environmental impacts to regulatory and scientific issues, such as the failure of Monsanto's Bollgard II to perform in Burkina Faso because of inadequate backcrossing. This technical mistake cost the cotton sector dearly.

The International Cotton Advisory Committee's roundtable report on biotechnology in cotton (2013) noted that all biotech cotton-producing countries had reported unintended consequences and had concerns regarding biotech cotton seed, which are mirrored in the statements of African civil society and farmer organisations.

Development of secondary pest populations

As reported in India and China, secondary pest populations increase as a threat because their natural predators have been removed or inadvertently controlled by applications of chemical insecticides (ICAC 2013). Colombia reported that the incidences and severity of diseases, notably ramularia, anthracnose and boll rot, are higher in biotech cotton than in conventional cotton varieties (ICAC 2013). Since 2006, farmers in the country have had to resort to multiple chemical treatments to manage these diseases (ICAC 2013). In India and Pakistan, secondary pest populations are on the rise, for example, mealybug, a relatively new pest to cotton (ICAC n.d.).

Development of resistance by target pests

Resistance in pests can happen quickly if refugia requirements, as part of a resistance management plan, are relaxed or ignored (ICAC 2013). To prevent the development of resistance, pest populations need ongoing monitoring to ensure early detection of increased tolerance to the Bt toxin and mitigation measures (ICAC 2013).

The issue of secondary pest emergence and increased pest resistance is largely unexamined in Africa (Dowd-Urbe & Bingen 2011). While the Bt toxin in the GM cotton repels the primary cotton pest – the bollworm – it does not repel secondary cotton pests, such as thrips, aphids, jassids and true bugs, and could lead to an increase in secondary pest populations on Bt cotton plots (Dowd-Urbe & Bingen 2011). This would necessitate increased spraying, thus negating the objective of GM technology (GMWatch 2014).

A 2006 study that surveyed 480 Bt cotton growers across five major cotton-producing Chinese provinces indicates that after seven years, Bt growers on average earned less than conventional cotton growers because of the need to treat the emergence of previously insignificant pests not susceptible to the Bt toxin (Dowd-Urbe & Bingen 2011). Chinese researchers have also found a high incidence of resistance to the Bt toxin among bollworms in Bt cotton fields in Qiuxian County, Hebei, where Bt cotton has been planted for more than a decade (Dowd-Urbe & Bingen 2011). Critics of this study note that there was only one toxin in this Bt cotton variety, and hence resistance was more likely, whereas it is less likely in Bt cotton containing two toxins (Dowd-Urbe & Bingen 2011). However, research conducted in 2009 indicates that resistance to Bt cotton containing two toxins is possible (Dowd-Urbe & Bingen 2011). Of particular concern are the pests that normally would be controlled by pesticides and only moderately repelled by Bt toxin, as they could pose a real threat to crops and negate the advantage of lowered pesticide spraying regimes (Dowd-Urbe & Bingen 2011). In 2009, farmers in Burkina Faso already noted increased levels of the cotton leafworm on Bt cotton fields

(Dowd-Urbe & Bingen 2011). Bt cotton thus needs increasing amounts of chemical spraying within a few years; reliance on Bt cotton as the only way of managing the bollworm is not sustainable.

Promoters of Bt cotton must consider the longer-term consequences of pest resistance and secondary pest dynamics, including the cost of spraying broad-spectrum pesticides on refugia and Bt cotton crops to control the emergence of secondary pests (Dowd-Urbe & Bingen 2011).

Increasing cost of GM seed

Stacked genes add considerably to the cost of the seed. Most countries reporting to the International Cotton Advisory Committee note the cost of biotech seed as a growing concern (ICAC 2013). The International Cotton Advisory Committee (2013) notes that plantings of GM cotton seed in rain-fed production areas in South Africa have decreased, with farmers saying that the increase in yields and savings on insecticides do not offset the technology fee for the seed.

The high cost of Bt cotton seed is likely to exclude relatively poor farmers from any benefit (Dowd-Urbe & Bingen 2011), unless they go into debt to buy it and the accompanying inputs. Repayment of this debt is then dependent on receiving a commensurate price on the global market, which is not a given in any year. A 10 kg sack of Bt cotton cost about \$60 in 2010/11 compared to conventional cotton at \$2 a sack (Dowd-Urbe & Bingen 2011). In South Africa, the cost for GM maize seed was 35% more than for conventional varieties (Adenle et al. 2013).

The benefits of lowered labour and spraying costs may not always outweigh the cost of the seed. In addition, the long-term costs of increased spraying for secondary pests or as resistance to Bt cotton rises should be considered. In its submission regarding GMO adoption, Malawi's Cotton Development Trust noted the high cost of seed as a primary concern (ACB 2015a). In many cases, as evidenced in India, farmers may take on the debt but be unable to repay it (Dowd-Urbe & Bingen 2011).



On-station field trial results do not automatically translate to the less controlled and significantly more diverse conditions on smallholder fields (Dowd-Urbe & Bingen 2011). For example, if rainfall is erratic at the start of the rainy season producers will often sow cotton seeds multiple times to achieve a viable crop (Dowd-Urbe & Bingen 2011), and using expensive GM seeds in this instance would affect economic viability of the crop. There are also concerns about the monopoly held on GM seed prices via patents (Morse 2009).

Genetic erosion

Out of the 50 known cotton species, only 5 are considered in the primary germplasm pool, 21 as secondary and 24 as tertiary germplasm pools, based on relative genetic accessibility (ICAC 2013).

A range of factors drive the decline in genetic biodiversity, including droughts, demographic pressure, changes in land-use, overexploitation and global warming

(KARI 2009). However, policies that advocate for high-yielding cultivars that displace traditional plant varieties are also recognised as influencing biodiversity levels (KARI 2009). This applies to GM cotton uptake as well.

Genetic diversity is an invaluable asset, particularly in this time of climate change, when we rely on a diversity of plant species and varieties, some with favourable traits to withstand harsh conditions. Low levels of genetic diversity, in which all individual species react similarly, can be problematic in changing environments (Landry 2015). GMOs can crossbreed with wild plants, creating a hybrid version, or their favourable traits can enable them to take over a population (Landry 2015). This hybrid version, with its insect or weed resistance built in, could provide the hybrid and its offspring with a 'fitness' advantage that would lead to its dominance and the diminishing of the genetic diversity of wild species through the absorption of resources (Landry 2015).

Cotton is a self-pollinating species and the potential for out-crossing exists (ICAC 2013). It is essential, then, that GM crops are managed properly to contain biotech traits and prevent transgenes from escaping into adjacent unregulated crops (ICAC 2013). This level of monitoring is not an integral part of smallholder farming systems.

Unregulated cross-boundary movement of GM seed

There is a high risk of unregulated cross-boundary movement of GM seed (De Ronde 2014). South Africa, which is the only country in Africa with GMO risk analysis standards equivalent to those of the EU, has significant shortcomings in governance of the system (Adenle et al. 2013). In Ghana, farmers brought seeds over the border from Burkina Faso – where GM cotton production has been halted, due to fibre length problems from the crops – and planted them out in open fields, with no supervision (Food Sovereignty Ghana 2015). Unregulated cross-border trading in maize seed is prolific in Africa; it stands to reason that GM cotton seed could easily pass unregulated between countries.

Additional burden of refugia

Refugias are an essential biosafety mechanism, but not one that is realistic in smallholder farming systems (ACB 2015a). However, Monsanto's claim in its application in Malawi, for example, that there is no need for structured refugias until adoption of the crop exceeds 80% of the planted area, is gambling with the future of Malawian farmers. While the application note that wild plants and non-cotton hosts can be used as refugias, it does not provide details as to where the 20% should be in relation to the 80% or its ability to act as a refuge (GMWatch 2014). In South Africa, government programmes to support small-scale production provided farmers with GM cotton seed, but did not adequately train farmers as to how to manage the technology, particularly the need for refugias (ACB 2015b). Consequently, farmers' inability to correctly manage refugias contributed to rising levels of insect resistance (ACB 2015b). In Burkina Faso, levels of insect resistance rose quickly, possibly because farmers were not able to manage refugias in a way that minimised this threat and the placement of 20% of fields to provide refugias is not practical for small farmers, as they cannot afford to lose the revenue (ACB 2015a).

A recent study conducted by the Indian Council of Agricultural Research's Central Institute for Cotton Research in 2014 and 2015 and published by *Current Science* found that GM seed companies have routinely flouted the regulatory requirement to provide non-GM seed for planting in refuges (Padmanabhan 2017). The study found in a random sampling of refugia packet seeds that almost a third had Bt seeds in them (Padmanabhan 2017). This points to a disregard for compliance with refugia guidelines, a vital pest-management strategy to prevent the rise of resistance among pest populations. It is widely assumed that it is lack of farmer knowledge or willingness to plant refugias that exacerbates the pest resistance problem, but this study highlights that seed companies also have a responsibility to ensure the correct seeds are supplied (Padmanabhan 2017).



Varying results in varying locations

The case for GM cotton is based on several untested assumptions. It assumes that its uptake will automatically generate higher yields and lower pesticide spraying frequency – and thus lower costs – and so generate higher profit margins for cotton farmers. Its appropriateness for each country context is determined by field trials prior to commercialisation. There is also an assumption that GM crop adoption is scale-neutral and will benefit all types of producers across all regions and conditions in the same way (Dowd-Urbe & Bingen 2011). However, a 2006 South African study found that different management practices and variable growing conditions created significant yield disparities between smallholder Bt cotton growers, even more so than in conventional cotton production (Dowd-Urbe & Bingen 2011). These significantly different results reflect in significantly different levels of profit (Dowd-Urbe & Bingen 2011).

Evaluations of Bt cotton's contribution to building food security and alleviating poverty tend to focus on the two narrow indicators of average yield and profit gain (Dowd-Urbe

& Bingen 2011). Increased yield in cotton does not necessarily translate to higher quality of cotton or higher profits, given that farmers operate in a global pricing system that is skewed by a multiplicity of factors, including subsidies. The adoption of Bt cotton in Burkina Faso serves as a prime example of how increased yields, but lower quality because of errors, does not result in increased profits.

Lack of evidence regarding socioeconomic benefits

There is a general lack of quantitative evidence regarding the promised socioeconomic benefits that accrue from adoption. For example, while some South African farmers have benefitted from the introduction of GM cotton, the expected job creation, rural development and economic growth were not realised, as the technology was introduced into a struggling sector faced with low global prices, cheap textile and garment imports and higher prices on offer for other crops, such as maize (ICAC 2013). While the technology increased productivity, it has not made South Africa competitive in the global market (ICAC 2013).



There is a general lack of clarity on how socioeconomic impacts will be measured, analysed and factored into biosafety decision-making processes (Okena et al. 2013). A 2003 World Bank study titled *Chad Cotton Sector Reform: A Case Study of Poverty and Social Impact Analysis* found that most benefits associated with GM crops in cotton-producing countries, with the exception at that time of China that had developed its own GM varieties, go to biotech and seed companies (ACB 2004). Widespread promotion of GM cotton could exacerbate the gap in farming communities between those who have and those who do not (Morse 2009). It would be important in Africa to understand the potential gains made across income and gender at the village level, to determine if significant social changes could transpire (Dowd-Urbe & Bingen 2011). It would also be important for governments to consider whether adoption and promotion of GM cotton would increase the risks that smallholders face in a volatile market (Dowd-Urbe & Bingen 2011). For example, all Bt cotton farmers will bear the brunt of the increased risk associated with climate variability (Dowd-Urbe & Bingen 2011).

It is noteworthy that no farmers in South Africa – commercial or small-scale – indicated that the main benefit of Bt cotton was increased yields (Gouse et al. 2003). Bt technology is aimed at reducing the use of pesticides, which it does in the short term. The cost savings generated through this can translate into higher profits for the farmer, but the cost of the technology must be accounted for, as well as the contractual obligations to plant refugia and follow pest management routines (Gouse et al. 2003).

There is a lack of inclusive and informed participatory consultation with the broader public about these issues in African countries. This is evidenced in Malawi, where the drivers of the process did not explore potential socioeconomic effects on rural livelihoods, which they should have, given the experiences in South African and Burkina Faso (GMWatch 2014). In Ghana, the public were made aware of GM cotton trials by unsupervised farmers taking place in the northern regions of the country through comments in local media about their success (Food Sovereignty Ghana 2015). In

Malawi, for example, there was also a lack of consultation with neighbouring countries regarding existing risk management plans for transboundary hazards (GMWatch 2014).

Greenpeace's 2015 report on the myths about GM crops noted that: there are no GM crops designed to deliver high yields; genetic engineering lags behind conventional breeding; there are no long-term environmental and health monitoring programmes for these crops; the cost-savings of GM production is proven to be false; and GM crops cannot coexist with conventional crops (Greenpeace 2015).

'Scrutiny of actual experience reveals a tragic tale of crippling debt, appalling market prices and a technology prone to failure in the absence of very specific and onerous management techniques, which are not suited to smallholder production.'
(ACB 2015a:3)

Organic cotton production?

There are alternative methods to control pests – intercropping, crop rotation and destruction of cotton plants immediately after harvest (InformationCradle. n.d.). Traditional methods include timely removal of pest host weeds, use of trap crops and use of resistant cotton cultivars (InformationCradle. n.d.). For example, use of tobacco leaf powder has consistently outperformed pesticides, without affecting natural enemy populations (InformationCradle. n.d.).

Organic production began in Tanzania and Uganda in 1994, in Zimbabwe in 1995 and in the early 2000s in Kenya and Zambia (Ferrigno et al. 2005). More than 25 500 cotton producers in Benin, Burkina Faso, Mali, Senegal, Tanzania and Uganda produced about 21 700 metric tons of organic cotton on 38 821 hectares in 2011, an average yield of 1 780 kg/ha (Farm Hub 2011). There is growing demand for organic cotton because consumers are increasingly aware of the social and environmental implications to conventional farming (Organic Cotton 2017). Cotton producers note the increasing challenge of finding organic cotton seed,

especially in countries that have adopted GM cotton (Russell 2015). They also note the potential of product contamination as being a threat to the organic cotton sector (Russell 2015). There are implications for export accreditation to GM-free countries, particularly to the EU, and, if cross-pollination occurs, for organic producers. The value of the organic cotton market was \$15.7 billion in 2014 and approval for accreditation up by 22% from the previous year (Russell 2015). The total amount of organic cotton used by the top 10 clothing brands has grown by 25% between 2014 and 2015 (Russell 2015). Several leading retailers, such as Swedish H&M, have pledged to source cotton only from sustainable sources by 2020 (Russell 2015).

Conclusion

Advocates for the promotion of GM cotton in Africa 'sell' their product within an emotive and groundless framing that use of these crops will boost yields and thus farmers' income, and therefore solve challenges of poverty and food security on the continent.

African countries are still recovering from the impacts of colonialism and structural adjustment programmes. Agricultural systems have not received the same level of support as they have in India, China, the EU and the US. The work to build up smallholder farming systems must be viewed as a long-term sustained effort. There is no quick fix, such as that proposed by adoption of GM crops.

Growers of organic cotton on the continent are producing yields close to those of their developed world counterparts and the management techniques have shown to reduce potable water usage by 91%,

energy demand by 62% and greenhouse gas emissions by 46% in comparison to conventional cotton production (Textile Exchange 2016). Soils with high organic matter, as prescribed under organic farming conditions, are less susceptible to drought or excessive rainfalls, providing farmers with more climatic resilient systems (Kloos 2015). The emphasis on the use of local and natural inputs also lowers farming risk (Kloos 2015), while the emphasis on agronomic techniques, as opposed to a technological input system, places control of production firmly in the hands of farmers (Organic Cotton 2017). And the market for organic cotton is growing with premium pricing.

The US must respect the right of African countries to produce food in a way that is socially just and environmentally responsible. It must stop its aggressive promotion of GMOs in African countries, where its application will not solve food insecurity, as evidenced in other parts of the world. African governments must look to the long-term viability and sustainability of their agricultural systems. As long as African cotton farmers are orientated towards a global market in which they must compete against unfairly subsidised producers, they will remain price takers, regardless of yield. Public funds must be channelled into solving farmer-identified problems: lack of institutional support, localised research and development, quality infrastructure and post-harvest facilities, and access to equitable markets. The goal must be oriented towards systems that put farmers at the core and support them in preparing for a future of climate uncertainty. To do this means ensuring resilient and localised seed systems geared towards adaptive behaviour, robust environmental systems with healthy soils, and research and development geared to responding to farmer needs.



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