Are genetically modified (GM) crops a commercial risk for Africa?

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Abstract: What risks might Africa face if it decided to plant genetically modified (GM) agricultural crops? A rough calculation based on current export profiles for one sampling of eastern and southern African countries suggests that the commercial export risks incurred outside of Africa would be quite small. Most of Africa's exports of goods that might be considered GM currently go to other African countries, rather than to Europe, Asia, or some other GM-sensitive destination. This raises a trade policy coordination challenge for Africa, but only a small commercial export risk beyond Africa.

Keywords: GMO; GM; Africa; agriculture; crops; food; exports; trade.

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1 Introduction

Africa's food crisis calls out for answers. In June 2004, at an international food conference in Ethiopia just prior to an African Union summit meeting, UN Secretary-General Kofi Annan observed that roughly one third of all adults in sub-Saharan Africa are currently malnourished. This hunger crisis is nearly certain to grow worse: crop yields in Africa tend to be much lower per hectare than in Asia or Latin America, and in 31 out of 53 African countries food output has actually been declining, while population is expected to double by 2030 to reach 1.5 billion. Many factors have deepened this food production crisis in Africa, including military conflicts which displace farming populations and interrupt production, and a growing AIDS crisis which infects roughly 27 million people on the continent and drains resources into care for the sick and dying, reducing further the availability of agricultural labour. Yet even in countries where political conditions are stable and HIV prevalence is still low, agricultural productivity in Africa lags. What Africa needs, according to Kofi Annan, is a revolution in farm productivity, "a uniquely African Green Revolution – a revolution that is long overdue, a revolution that will help the continent on its quest for dignity and peace.[1]" What might this uniquely African revolution in crop productivity look like?

Africa mostly missed the original Green Revolution of the 1960s and 1970s, which brought higher yielding varieties of wheat and rice into Asia, made productive through expanded irrigation and increased applications of chemical fertiliser. These conventionally developed Green Revolution 'miracle seeds' worked well under the conditions that prevailed in much of Asia: good water and topography for irrigation, access to credit for the purchase of chemical inputs, adequate road systems to get the fertiliser in and the expanded grain production out, and established local traditions of growing crops in monoculture, including wheat and rice. In most of Africa these conditions do not exist. Most farmers do not grow Green Revolution crops such as wheat or rice in monoculture; instead they intercrop cash crops such as cocoa or cotton along with a wide variety of subsistence food crops (cassava, sorghum, millet, cowpea, yams, banana) that have not yet been improved by local crop breeders. More important, Africa's long dry seasons and uneven topography have made bringing water to crops through irrigation difficult, and the rural road and credit systems in Africa are weak, which drives up the cost of fertiliser and drives down the crop price received by farmers (Evenson and Gollin, 2003).

Under these challenging circumstances, the options for creating a 'uniquely African Green Revolution' might seem limited. One new technical option is the development of new crop varieties through genetic engineering techniques, which splice desired genes into crop plants from more distant relatives, or even non-relatives. A first generation of these genetically modified (GM) agricultural crops was developed by private seed companies in the 1990s and included insect-resistant cotton and maize, engineered to contain genes from Bt*,* a soil bacterium that produces a protein that many kinds of insects cannot digest. Farmers that plant Bt varieties of cotton and maize can control insect damage with fewer sprays of toxic insecticides. Another early genetic trait engineered into GM crops was resistance to the herbicide glyphosate (trade name Roundup). Fields planted with 'Roundup Ready' GM crops can be kept free of weeds usually with a single application of glyphosate, which allows farmers to save the cost of multiple applications of weed killers that can be more toxic and more persistent in the environment. Before this first generation GM seeds were released for commercial sale to farmers in 1995–1996, government regulators in the USA, Europe, Japan, and elsewhere screened them for risks to human health and the environment, and found no increase in such risks compared to conventional crops.

This crop revolution has been a success on its own terms, at least in some of the more prosperous commercial farming regions for which most GM crops have been developed. Where farmers have been permitted to plant these first generation GM crops, they have performed largely as advertised, saving both time and money by reducing the need to purchase and spray expensive and toxic chemicals to controls insects and weeds (FAO, 2003; Nuffield Council on Bioethics, 2003). Soybean farmers in the USA, Argentina, and Brazil have embraced glyphosate-resistant varieties, and as a consequence 55% of all soybean hectares world-wide are planted to these GM varieties. Cotton farmers in the USA, China, India, and South Africa are now planting Bt cotton, and as a consequence more than 20% of all global cotton hectares are GM. Maize farmers in the USA and Argentina have widely adopted GM varieties as well.

The spread of this first generation of GM crops continues at a steady pace. In 2004, the global area planted to GM crops grew at a annual rate of 20%, the ninth consecutive year of double-digit growth, and the estimated global area planted to GM crops increased to 81.0 million ha, up from 67.7 million ha in 2003. GM crops were grown in 2004 by approximately 8.25 million farmers in 17 countries, up from 7 million farmers in the previous year. Temperate zone commercial farming still dominates in terms of area planted to these new crops. Considering GM crop area, the top eight countries in descending order were: USA with 47.6 million ha (59% of global total), followed by Argentina with 16.2 million ha (20%), Canada 5.4 million ha (6%), Brazil 5.0 million ha (6%), China 3.7 million ha (5%), Paraguay with 1.2 million ha (2%) reporting biotech crops for the first time in 2004, India 0.5 million ha (1%), and South Africa 0.5 million ha (1%). Yet because of the large number of very small farmers planting GM cotton in China and India in 2004, roughly 90% of the individual growers of these crops around the world are now resource-poor farmers from developing countries (James, 2004).

This recent spread of GM crops is commercially interesting, yet it has been primarily centred in farming regions that were already productive rather than in the struggling regions of Africa. Why has the new ‘gene revolution’ failed, so far, to deliver greater productivity benefits to Africa, where the benefits are needed most?

In some cases today’s ‘Gene Revolution’ GM crops are just as poorly suited to African conditions as the earlier ‘Green Revolution’ wheat and rice varieties from the 1960s and 1970s. Not many farmers in Africa grow soybeans, and even if they did the purchase of expensive GM seeds might not be affordable. Yet a number of African farmers do grow cotton and maize, crops that have been improved through GM, and evidence suggests that African farmers might indeed profit if they had access to these seeds. In the Republic of South Africa, small-scale farmers in Makhathini Flats in KwaZulu Natal have been allowed by their government to plant genetically modified Bt cotton since 1997–1998, and one study in 2001 showed that when these farmers switched from conventional to Bt cotton they suffered less insect damage, sprayed fewer insecticides, and enjoyed an average net income gain of $50 per hectare per season (James, 2002). The experience of other small farmers beyond Africa seems to confirm that a switch to Bt cotton could increase farm income per hectare. Evidence gathered in Gujarat, in India, compared gross margins per hectare for farmers planting the Bt hybrid MECH 12 vs. non-Bt varieties, and despite much higher seed costs the gross margin for farmers planting Bt cotton was 32% higher (Morse et al., 2005). The largest estimates of income gains for small farmers from planting Bt cotton have come from China. Survey data collected from Chinese farmers in Hebei and Shandong provinces over the period 1999–2001 showed average income gains of $357 per hectare from planting Bt cotton compared to non-Bt cotton in 1999, average gains of $650 per hectare in 2000, and average gains of $502 per hectare in 2001 (Huang et al., 2002).

African farmers might also benefit from planting Bt maize, to protect against insects. South Africa first approved the planting of Bt yellow maize in 1997, and by 2002 roughly 20% of this nation’s maize crop was GM, with the net income of GM maize farmers increasing on average $27 per hectare per year, under non-irrigated conditions. Bt maize was also commercialised in the Philippines in 2002, and Bt hybrid yellow maize is now being grown there by small as well as large farmers on roughly

49,000 acres of land. In a study conducted in the 2003–2004 planting seasons, researchers reported that Bt corn farmers experienced a 37% increase in yields, reduced insecticide costs by 60%, and increased their profitability by 88%, or 10,132 Pesos ($170) per hectare, despite seeds that cost roughly twice as much as conventional hybrids (Yorobe and Quicoy, 2004).

It thus seems regrettable that so few African farmers have been given official permission by their governments to plant any GM crops. Except for South Africa, the commercial planting of GM crops – even cotton – has not yet been approved anywhere on the African continent. The slow progress toward approval of GM crops in Africa reflects at least three separate policy fears: food safety fears, environmental safety fears, and fears of losing commercial sales of farm products abroad. How justified, in each case, are these fears?

2 Food and environmental safety

When GM crops were first planted, it was easier for critics and skeptics to use the novelty of this technology to raise questions about safety to consumers, and also to the environment. Particularly in Europe, were official food safety regulators were not widely trusted (in part because they had been wrong about BSE), early assurances from governments that it was safe to plant and eat GM crops encountered skeptical resistance. With the passage of time, however, the legitimate foundations of this skepticism have been weakened. For ten years now, authoritative agencies have had a chance to study the actual performance and impact of this first generation of approved crops under field conditions and in the food chain, and they have so far found no credible scientific evidence of added risks to human health or to the environment, compared to the conventional crop counterparts.

Agencies in Europe as well as the USA have drawn this benign conclusion. In 2001, the Research Directorate General of the European Union (EU) released a summary of 81 separate scientific studies conducted over a 15 year period (all financed by the EU rather than private industry) aimed at determining whether GM products were unsafe, insufficiently tested, or under-regulated. None of these studies found any scientific evidence of added harm to humans or to the environment from any approved GM crops or foods (Kessler and Economidis, 2001). In December 2002, the French Academy of Sciences and Medicine drew a similar conclusion (French Academy of Sciences, 2002). The French Food Safety Agency (AFSSA) also agreed. In May 2003, the Royal Society in London presented to a government-sponsored review in the UK two submissions, which found no credible evidence that GM foods were more harmful than non-GM foods (Royal Society, 2003). The British Medical Association (BMA), which earlier in 1999 had issued an 'interim statement' saying it was too soon to endorse GM foods, now went along with the position of the Royal Society (BMA, 2004). Then the Union of German Academies of Science and Humanities issued a similar scientific advisory, saying the GM crops approved so far were as safe as their conventional counterparts, and in some instances superior and safer. Finally, in May 2004, the Food and Agriculture Organization (FAO) of the United Nations issued a 106 page report summarising the evidence – drawn largely from a 2003 report of the International Council for Science (ICSU) – that

> "To date, no verifiable untoward toxic or nutritionally deleterious effects resulting from the consumption of foods derived from genetically modified foods have been discovered anywhere in the world."

On the matter of environmental safety, this same FAO report found that the environmental effects of the GM crops approved so far – including effects such as gene transfer to other crops and wild relatives, weediness, and unintended adverse effects on nontarget species (such as butterflies) – have been similar to those that already existed for conventional agricultural crops (FAO, 2004).

A clear scientific basis for resisting GM crops has thus been found lacking so far, yet many governments in Africa nonetheless remain wary. Sometimes this wariness can take an extreme form, as when the Government of Zambia refused in 2002, in the midst of a severe drought-induced food emergency, to accept maize from the USA as food aid, because bulk shipments of US maize were known to contain some GM varieties. Other states struggling against this same 2002 drought emergency did accept US maize as food aid, but only if the kernels were first milled, so they could not be planted by farmers. One motive behind this unusual demand was not food safety, or even environmental safety, but instead a commercial fear: a fear that if GM maize kernels imported from the USA as food aid were planted by African farmers, then Africa's maize crop might become 'GM-contaminated', making it more difficult to export maize – or meat from animals fed with maize – to markets in Europe where consumers do not like GM. Thus, even if African governments are willing to accept GM food products as safe for human consumption and for the environment, they remain wary of planting GM crops for fear of losing commercial export sales to GM-sensitive markets. How well grounded is this fear?

3 Measuring commercial export risks

African states do have reason to fear a loss of some commercial exports if GM crops are planted, yet the dollar value of the exports at risk will usually be very small, because most of Africa's agricultural exports do not consist of the products – such as soybean or maize – that are currently available in GMO varieties, and when African countries do export such 'possibly GMO' products it is usually to other African countries, rather than to Europe, Asia, or GM-sensitive destinations.

European importers do sometimes turn away shipments they view as 'contaminated' with GMOs. For example, the nations of the EU stopped importing bulk shipments of maize from the USA in 1998, at an annual cost to US exporters of $250 million, because some GM maize varieties grown in the USA had not yet been approved in Europe. The EU began lifting this de facto moratorium on new GM crop approvals in 2004, but only while replacing the moratorium with a new set of labelling and tracing regulations that that left even products that had been officially approved burdened and stigmatised, including processed products and animal feeds that had not previously required a label. In some cases private European import firms have gone beyond the terms of official restrictions by refusing to buy even the meat of animals that might have been raised on GM feeds (beef from Namibia was once turned away by a private importer because it had been fed GM maize from South Africa). To a lesser extent, importers in Asia and in the Arab World have also become GM-sensitive, and have begun following the European practice of either shunning GM products or burdening and stigmatising them with market segregation, testing, and labelling requirements.

The commercial export risks for Africa are therefore real, yet on inspection they prove to be small. This paper reviews the recent trade patterns of more than 12 countries in Eastern and Southern Africa and finds that only a small share of total farm exports from these states have been ‘possibly GM’ products, and that only a small share of these sensitive exports are going to GM-sensitive markets such as the European Union. We make this calculation first by assembling a list of export products that might be viewed by sensitive importers as ‘possibly GM’, and hence shunned. We construct this list first by including all commodities (and products of commodities) that have been approved for commercial production in GM form somewhere in the world, then we add to this list all live animals and animal products, since it is possible that these too could be shunned if it were suspected that the animals in question were raised on GM feed (such as GM Maize or soy). We also add to this list natural honey, since it might be viewed as ‘GM’ if some of the pollen gathered by the bees was from a GM maize or cotton plant. The result is quite a long list of ‘possibly GM products’, (Table 1) many of which are important in international trade.

Table 1 Possibly GM export products

Live animals
Meat
Dairy
Potato
Tomato
Papaya
Squash
Soybean and rape, including oil, flour and meal
Maize
Maize flour and meal and bran
Maize hulled
Cottonseed oil and cake
Natural honey

Several observations can be made regarding this list. First, while it is a fairly long list of products, some quite important in international trade, it has also recently been a somewhat static list. Most of the products on this list were first commercialised in GM form in the USA in the middle 1990s. Few new products have been added to this list in the past six years. Two major food grains – wheat the rice – have been developed in GM form in the laboratory and field tested, but GM wheat has not yet been given an official commercial release in any country, even the USA or China, and as of 2005, GM rice had been given only a small scale commercial release in one country, Iran. Second, while the ‘possibly GM’ products on this list are indeed important in international trade, they are not particularly important in the export trade of most countries in Africa. African countries still rely heavily on the export of agricultural products as a source of foreign exchange earnings, but the most valuable of Africa’s traditional export crops – including coffee, tea, sugar, banana, cocoa, oil palm, peanuts – have not yet been commercialised anywhere in GM form, so there is little risk that importers will shun them. Likewise for the most valuable of Africa's new 'non-traditional' farm exports, such as green beans, onions, mango, pineapple, or avocado. Industrial products such as cotton are not on this list because they are not used for food or feed. Even the most sensitive importers in Europe have been willing to import cotton lint and fibre from GMO cotton plants. It is only the oil or meal of cotton seeds, which can be used as a food or feed, that must be placed on this list.

UN trade data, available from the United Nations Commodity Trade Statistics Database,[2] allow us to measure the absolute and relative importance of these 'possibly GM' food and feed exports from a range of eastern and southern African countries. In Table 2, we present 2003 export trade data for 16 African countries, showing first the total dollar value of all agricultural exports, as calculated by the Food and Agriculture Organization (FAO) of the United Nations, and then the 'possibly GM' share of that export value as calculated from UN Comtrade:

Table 2 Value, share, and destination of 'possibly GM' agricultural exports for 16 African countries, 2003

	Total Ag. exports (*$ million*)	*Of which 'possibly GM'* (*$ million*)	*Percentage of total that are 'possibly GM'*	*Destination of 'possibly GM' exports* (*as Percentage of all 'possibly GM'*)				
				Europe	*Asia*	*Arab world*	*Africa* (*non-Arab*)	*Rest of world*
Burundi	31	0.003	0	58	0	42	0	0
Comoros	20	0.01	0	13	0	0	60	27
Egypt	938	80	9	47	0	49	2	1
Ethiopia	450	10	2	0	0	96	0	4
Kenya	1291	15	1	0	1	15	80	4
Madagascar	194	0.9	0	17	15	14	9	44
Malawi	426	10	2	0	0	0	99	0
Mauritius	355	18	5	55	0	5	8	32
Namibia	226	88	39	0	0	0	99	1
Rwanda	29	0.4	1	12	0	0	88	0
Sudan	389	146	38	0	0	100	0	0
Swaziland	157	10	6	14	0	0	85	1
Tanzania	408	23	6	6	2	3	85	4
Uganda	116	8	7	0	0	0	99	0
Zambia	119	5	4	4	0	0	95	0
Zimbabwe	721	68	9	10	0	3	87	0

Source: UN Comtrade; FAOSTAT

Looking at the third column of Table 2, we can see that 'possibly GM' products make up only a small share of total agricultural exports for most of these African countries. Namibia and Sudan are the only countries on this list with a commercial export risk exposure greater than 10% of all agricultural exports if exports of all 'possibly GM' were suddenly to be lost. This reflects the dependence of these two countries on exports of 'meat and the live animals', and we have included such products as possible for some highly sensitive importers to shun. Namibia's exposure comes from the heavy weight in its agricultural exports of live cattle, sheep and goats, beef, veal, and mutton. A more likely product to be shunned, maize, is not an important part of Namibia's export trade. Maize exports from Namibia in 2003 totalled only $2 million, just a trivial share of total agricultural exports. Sudan's export risk exposure is even more greatly exaggerated by the percentage number shown in column 3 of Table 2, since almost all of Sudan's 'possibly GM' exports are live animals, particularly sheep and camels. These are animals unlikely to be fed on maize or soy, and they not primarily imported for food in any case. Sudan's total maize exports in 2003 totalled only $2 million, once again just a tiny share of all agricultural exports for that country.

Excluding Namibia and Sudan, the countries on this list with the greatest percentage exposure overall appear to be Egypt and Zimbabwe. Column 2 indicates that Egypt might have lost $80 million in export sales in 2003 if Egypt had begun planting GM crops and if all of its foreign customers had consequently stopped buying all of its 'possibly GM' products. The bulk of these exports at risk were potato ($44 million), dairy products ($24 million), and meat from live animals ($11 million). The importance of potato exports for Egypt helps explain why that country resisted early USAID efforts to develop GM potatoes in that country. GM potatoes are no longer being grown even in the USA, since fast food chains decided they did not want to be accused of selling GM French fries. Egypt also has reason to be concerned about its meat and dairy exports, given the large combined share of those products that go to sensitive markets such as Europe (column 4) and the Arab world (column 6). In the case of Zimbabwe, the 9% of that country's agricultural exports that were 'possibly GM' in 2003 were primarily animal products once again. Bt maize might have once been a sensitive crop to plant in Zimbabwe, when it was a significant net exporter of maize to the region, but in 2003 Zimbabwe exported only $8 million worth of maize and maize products, only 1% of total agricultural exports.

When considering the export destinations of these sensitive 'possibly GM' products, Table 2 provides reassurance to most of the African countries considered here. Not all export destinations are equally likely to shun 'possibly GM' imports following a decision by an exporter to start planting GM crops. The highest risks of losing export sales due to consumer resistance or regulatory restriction are found in Europe, but risks may be encountered in Asia and in the Arab world as well. Fortunately, columns 4–8 of Table 2 show the vast majority of 'possibly GM' exports from these 16 countries currently do not go to Europe, Asia, or the Arab world. By far the most frequent export destination for 'possibly GM' products from these selected African countries was other (non-Arab) countries in Africa itself. For 9 of these 16 countries, 80% or more of 'possibly GM' exports went to non-Arab countries within Africa. Europe or the Arab world were primary export destinations only for the possibly GM products of Burundi, Egypt, Ethiopia, and Mauritius. Asia was a primary export destination of possibly GM products for none of these countries. A conclusion might be drawn that the commercial export risks African governments will incur from allowing the planting GM crops will depend not on government policies and consumer tastes in Europe, but on the consumer tastes and import policies of other African governments.

By combining information contained in columns 3–6 in Table 2, we can provide an even more refined commercial export risk measurement. Table 3 shows a percentage measure of the share of total agricultural exports that are *both* 'possibly GM' and currently going to a highly GM-sensitive destination, such as Europe, Asia, or the Arab world.

Table 3 Percentage of agricultural exports 'possibly GM' and also going to highly GM-sensitive destination, 2003

Burundi	0
Comoros	0
Egypt	9
Ethiopia	2
Kenya	0
Madagascar	0
Malawi	0
Mauritius	3
Namibia	0
Rwanda	0
Sudan	38
Swaziland	1
Tanzania	0
Uganda	0
Zambia	0
Zimbabwe	1

The high Sudanese number in Table 4 is of dubious significance, remembering that most of these exports are not to Europe or Asia but to Arab countries, and are not possibly GM commodities like maize, or even meat or dairy products possibly raised on GM feed, but live sheep and camels intended for non-food use. Egypt is the only country on this list that appears to have legitimate fears of significant export losses in the 10% range, if farmers were given permission to plant GM crops, and if the assumed consequence were a loss of all export sales to all GM-sensitive markets beyond Africa. For all other countries in this group, the commercial export risks that might result from allowing the planting of all GM crops, even in this worst case scenario, currently appear to be vanishingly small.

4 Export risks an African problem

Table 2 revealed that by far the largest share of the possibly GM exports of these African states go to other African states. By implication, most of the export risks facing Africa from GM crops will be risks that Africans themselves are in a position to manage. Significant commercial risks and trade disputes will arise only if African countries themselves fail to agree on a harmonised system governing the movement across their national borders of products such as GM maize, or products from animals fed with GM maize. Prompted by the food aid controversy of 2002, governments in eastern and southern Africa began sensing a need to harmonise their policies toward trade in GM crops and foods, and in November 2002, the agricultural ministers of the Common Market for East and Southern Africa (COMESA) countries, meeting in Kampala, agreed to move toward a regional policy toward GMOs, including GMOs coming into Africa as food aid.

Constructing a truly 'regional' policy governing GM product trade will be a challenge. The prevailing approach in Africa has been to treat GMO policy as an independent sovereign choice to be made separately by each national political system. On the question of accepting GM food aid, this traditional state-by-state approach has been endorsed explicitly by the Southern African Development Community (SADC) and accepted by the United Nations World Food Programme (WFP). For commercial imports of GM products, the sate sovereignty approach is also implicitly endorsed by the Cartagena Protocol on Biosafety and also by the AU African Model Law. The challenge will be for states to use their sovereignty to negotiate regional agreements that harmonise policies, or mutually recognise and honor the policies of other states.

One way to ensure that the borders of most African states remain open to the 'possibly GM' exports of other African would be to embrace the distinction made in Cartagena Protocol on Biosafety between transboundary movements of living GMOs (LMOs) intended for human consumption or processing vs. those intended for planting in the environment. Virtually all of the cross-border maize trade taking place in Africa today is for consumption or processing, not planting, and the Cartagena Protocol places quite a low minimum regulatory standard on food trade (including food aid) of this kind: the exporter must notify importers that the shipment 'may contain' LMOs and must notify that the grain is not meant for 'intentional introduction into the environment'.[3] Beyond this, importers and exporters can treat these LMO shipments in the same way they treat conventional food shipments. One option for Africa, then, would be to ask all governments in the region to adopt this permissive Cartagena Protocol approach to LMO imports intended for human consumption.

If governments wish to go above this permissive minimum by demanding milling prior to delivery, or by banning all imports (including food aid) with GM content, this would be their sovereign right under the Cartagena Protocol. Yet governments that restrict imports in this fashion might be required to take on two obligations. First, they might be required to give the WFP a warning in advance of any new milling requirements or GM import bans they plan to impose, to facilitate the sourcing adjustments and funding mobilisation efforts these requirements might imply. Second, they might be required, particularly if they are port-of-entry countries for land-locked neighbouring states, to make an exception and revert to the basic Cartagena Protocol standard when GM food aid is being transshipped through their territory to neighbouring states, or to camps holding refugees. Of course, the best long-term solution to the GM food aid import policy dilemma will be to reduce the need for food aid imports by improving the livelihoods and increasing the agricultural productivity of those who now periodically become food aid recipients.

5 The future of GM crops in Africa

Until now it has been relatively easy for critics of GM crops to dismiss the potential of this technology in Africa, because private international companies when taking the early lead developed products such as GM soybeans grown primarily by wealthy commercial farmers in the Temperate Zone countries, rather than GM varieties of sorghum, cowpeas, or cassava the 'orphan crops' grown by poor farmers in the tropics. This market-driven misdirection of research priorities continues to constrain the deployment of GM crops to poor farmers, although not perhaps forever.

One new departure has been a recent competition, among all three of the big GM crop companies – Syngenta, DuPont, and Monsanto – to develop crops with drought-tolerance (DT) traits. Scientists within these companies have now successfully isolated genes conferring significant drought tolerance, and they have transferred these genes using genetic engineering into agricultural crop plants such as soybean, rice, and maize, with exciting results in early greenhouse and field trials.[4] If DT traits such as these can eventually be transferred to tropical varieties of maize, wheat, rice, sorghum, or millet, they could offer poor African farmers something far more valuable than the insect resistance or herbicide resistance traits of the first generation of GM crops. DT crops would give small farmers in Africa, and also in the drylands of South Asia, a partial safety-net against the cyclical food crises that afflict these regions whenever rains fail. The 2001–2002 drought in Southern Africa put 15 million people at risk and required a massive food aid response from the international community. An earlier drought in 1991–1992 had been even more severe, putting 18 million people – many of them poor maize farmers – at a food security risk and in need of international food aid.

A next generation of genetically engineered DT crops might thus begin to provide for Africa something closer to the 'uniquely African Green Revolution' that Kofi Annan called for in 2004. To open the way for that possibility, governments in Africa must begin to see that the commercial export risks of allowing GM crops to be planted will for the most part be risks that the African governments themselves can control.

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Notes

[1]Text of remarks available at: http://www.un.org/News/Press/docs/2004/sgsm9405.doc.htm.

[2]UN Comtrade, at http://unstats.un.org/unsd/comtrade/.

[3]Cartagena Protocol on Biosafety.

[4]For a preliminary discussion of these results see DuPont/Pioneer online at http://media.corporate-ir.net/media_files/NYS/DD/presentations/Oestreich1.pdf, and the Monsanto Company online at http://www.monsanto.com/monsanto/content/investor/financial/presentations/2004/20041208.pdf.