AFRICA'S FOOD CRISIS:
ARE GENETICALLY MODIFIED (GM) CROPS PART OF THE ANSWER?

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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 labor. Yet even in countries where political conditions are stable and HIV prevalence still low, agricultural productivity in Africa remains low as well. 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 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, accompanied by expanded irrigation and increased applications of chemical fertilizer. These conventionally developed Green Revolution "miracle seeds" worked well under the conditions that prevailed in much of Asia – good water and topography conditions for irrigation, access to credit for the purchase of chemical inputs, adequate road systems to get the fertilizer 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 did not exist. Farmers did not grow wheat or rice in monoculture; instead they intercropped cash crops such as cocoa or cotton along with a wide variety of subsistence food crops (cassava, sorghum, millet, cowpea, yams, banana) not yet improved by local crop breeders. More important, Africa's long dry seasons and uneven topography made bringing water to crops through irrigation difficult, while the rural road and credit systems in Africa were weak, which made both the purchase of fertilizer and the marketing of farm products impossible or unprofitable.

Under these challenging circumstances, the options for creating a "uniquely African Green Revolution" might seem limited. Yet one powerful new technical option has recently become available: the development of new crop varieties through genetic engineering techniques, which give scientists new ways to add desirable new genetic traits to crop plants. Scientists are no longer limited to the laborious task of breeding desired for traits by conducting repeated crosses between close plant relatives. They can now use recombinant DNA techniques to splice in genes from more distant relatives, or even non-relatives.

The new science of genetic engineering has already produced some highly useful results for farmers. A first generation of GM agricultural crops, developed by private seed companies in the 1990s, has 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. *Bt* occurs naturally in the soil and is widely used by organic farmers to control insects. Farmers that plant *Bt* varieties of cotton and maize can control insect damage with many fewer toxic insecticide sprays. Another early genetic trait engineered into GM crops was resistance to the herbicide glyphosate (trade name Roundup). Fields planted with these "Roundup Ready" crops could be kept free of weeds with a single application of glyphosate, which allowed farmers to save the cost of multiple applications of weed killers that were more toxic and more persistent in the environment. Before these first generation GM seeds were first released for sale to farmers in 1995-96, government regulators in the United States, 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.

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

The GM crop revolution has been a spectacular success on its own terms. Where farmers have been permitted to plant these first generation GM crops the seeds have performed as advertised, saving both time and money by reducing the need to purchase and spray expensive and toxic chemicals to controls insects and weeds. Soybean farmers in the United States, Argentina, and Brazil have avidly embraced glyphosate-resistant varieties, and as a consequence 55 percent of all soybean hectares world-wide are planted to these GM varieties. Cotton farmers in the United States, China, India, and South Africa are now planting *Bt* cotton, and as a consequence more than 20 percent of all global cotton hectares are GM. Maize farmers in the United States and Argentina have widely adopted GM varieties as well.

The spread of GM crops continues at a rapid pace. In 2004, the global area planted to GM crops grew at a annual rate of 20 percent, the ninth consecutive year of double-digit growth, as the estimated global area planted to GM crops increased to 81.0 million hectares, up from 67.7 million hectares 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 the area planted to these crops. In terms of GM crop area, the top eight countries in descending order were: USA with 47.6 million hectares (59% of global total), followed by Argentina with 16.2 million hectares (20%), Canada 5.4 million hectares (6%), Brazil 5.0 million hectares (6%), China 3.7 million hectares (5%), Paraguay with 1.2 million hectares (2%) reporting biotech crops for the first time in 2004, India 0.5 million hectares ((1%), and South Africa 0.5 million hectares (1%). Yet because of the large number of very small farmers planting GM cotton in China and India in 2004, roughly 90 percent of the individual growers of these crops around the world are now resource-poor farmers from developing countries. [2]

This recent spread of GM crops is commercially interesting, yet it has primarily been centered on already productive farming regions rather than on the struggling region of Africa. Why has the new "gene revolution" failed, so far, to deliver greater productivity benefits to the struggling farmers of Africa, where those benefits are needed the most?

Some try to argue that 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. For example, 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 these African farmers do purchase seeds and do profit when they have access to insect resistant GM varieties of cotton and maize. In South Africa, small farmers in Makhathini Flats in KwaZulu Natal have been allowed by their government to plant genetically modified *Bt* cotton since 1997/98, 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.[3] Once group of academics in South Africa projected these South African results to the rest of the continent and estimated that adopting *Bt* cotton might generate additional incomes of roughly $600 million for farmers elsewhere in Africa. 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 percent of this nation's maize crop was GM, with the net income of GM maize farmers increasing on average $27 dollar per hectare per year, under non-irrigated conditions.

It thus seems regrettable that so few African farmers have been given official permission by their governments to plant GM crops. Except for South Africa, the commercial planting of GM crops – even cotton – has not yet been approved anywhere on the African continent. These African governments continue to block the planting of GM crops for three officially stated reasons: food safety fears, environmental safety fears, and fears of losing commercial sales of farm products abroad. How justified is each of these fears?

Food and Environmental Safety

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[2] Clive James, "Preview: Global Status of Commercialized Biotech/GM Crops: 2004. ISAAA.

[3] Clive James, "Global Review of Commercialized Transgenic Crops: 2001. Feature: *Bt* Cotton." International Service for the Acquisition of Agri-Biotech Applications (ISAAA), Brief No. 26-2002, Ithaca, New York: ISAAA, 2002, p. 132.

When GM crops were first being planted, it was possible 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 (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 foundation of this skepticism has been greatly weakened. Respectable agencies have now recorded and studied the performance of the first generation of approved crops for nearly a decade, and they have so far found no credible scientific evidence of added risks to human health or to the environment, compared to the conventional crops that are counterparts to these GM varieties.

Agencies in Europe as well as the United States have drawn this reassuring 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.[4] In December 2002, the French Academies of Sciences and Medicine drew a similar conclusion. This report blamed the rejection and over-regulation of GM technologies in Europe on what it called "propagation of erroneous information." 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. 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. 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 summarizing 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.[5] In this report, Jacques Diouf, the Director-General of FAO, strongly endorsed the spread of more productive GM crops into poor countries, noting that the world would need to feed an additional two billion people by 2030, including 750 million more in Africa alone.

A scientific basis for resisting GM crops thus has been found lacking, 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 – to accept maize from the United States as food aid, because bulk shipments of U.S. maize were known to contain some GM varieties. Other states also struggling against this 2002 drought emergency did agree to accept U.S. maize as food aid, but only if the kernels were first milled, so they could not be planted by farmers. One important 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 United States as food aid were planted by African farmers, then Africa's maize crop might become "GM-contaminated" making it more difficult to export either maize, or meat from animals fed with maize, to markets in Europe where consumers do not like GM and where regulations against GM have been proliferating. Even African governments willing to accept GM food products as safe for human consumption and for the environment have still been wary of planting GM crops, for fear of losing commercial farm export sales to GM-sensitive markets abroad. How well is this fear?

Measuring Commercial Export Risks

[4] Charles Kessler and Ioannis Economidis, eds., *EC-Sponsored Research on Genetically Modified Organisms: A Review of Results.* Brussels: Research Directorate-General, European Commission, 2001

[5] Food and Agricultural Organization of the United Nations (FAO). *The State of Food and Agriculture 2003-04: Agricultural Biotechnology: Meeting the Needs of the Poor?* (Rome: FAO, 2004).

Africa has reason to fear some loss of commercial exports if GM crops are planted, but for most African states the dollar value of the commercial exports that would be at risk, particularly in sales to Europe, would be remarkably small.

Markets that are "sensitive" to GM products have been known to turn away exports of GM commodities. For example, the nations of the EU stopped importing bulk shipments of maize from the United States in 1998, because some GM varieties grown in the U.S. had not yet been approved in Europe. The EU began lifting its de facto moratorium on new GM crop approvals in 2004, but only while replacing it with a new set of labeling and tracing regulations that will tend to stigmatize any products exported to the EU with GM content, including processed products and animal feeds that did not previously require a label. In some cases private importers have gone beyond the terms of these official restraints by refusing to import even the meat of animals that were raised on GM feeds (beef from Namibia was turned away 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 followed the European practice of either shunning or stigmatizing GM products.

So the commercial export risks for Africa are real. But a review of recent trade patterns reveals that only a small share of Africa's total farm exports are "possibly GM" products, and only a small share of these possibly GM exports go to GM-sensitive markets such as the European Union.

If we count as "possibly GM products" all of those that have been approved for commercial production in GM form somewhere in the world, plus all animal products that could possibly be fed with GM feeds such as soy or maize, we can generate quite a long list of "potentially GM products" that are important in international trade, including the following categories of products as referenced by COMTRADE, within the United Nations Statistics Division:

Live Animals
Meat
Dairy
Potato
Tomato
Papya
Soybean and Rape, including oil, flour and meal
Maize
Maize flour and meal and bran
Maize hulled
Cottonseed oil and cake

These "possibly GM" products are important in international trade, but as it turns out not particularly important in the export trade of most countries in Africa. The most valuable of Africa's export crops – including fruits and vegetables, coffee, tea, sugar, banana, cocoa, oil palm, peanuts – are not on this list because GM varieties of these products either do not yet exist or have not yet been commercialized anywhere in the world, so importers of these products needn't fear "GM contamination." Raw cotton and cotton fibre are not on this list because they are industrial products, not food or feed products, and their GM content encounters no consumer or regulatory resistance.

UN trade data allow us to measure the absolute and relative importance of Africa's "possibly GM" food and feed exports. In Table 1 we present 2002 export trade data for 16 African countries that are members of the Common Market for Eastern and Southern Africa (COMESA), showing first the total dollar value of all agricultural exports and then the "possibly GM" share of that export value:

Table 1: Possibly GM Share of Agricultural Exports 16 COMESA Countries, 2002

	Agricultural Food and Feed Product Exports 2003		
	Total ($	Of which "Poss. GM"	% "Possibly GM"

	million)	($ million)	
			0
Burundi		.003	0
Comoros	31	.01	9
Egypt	20	80	2
Ethiopia	938	10	1
Kenya	450	15	0
Madagascar	1291	.9	2
Malawi	194	10	5
Mauritius	426	18	39
Namibia	355	88	1
Rwanda	226	.4	38
Sudan	29	146	6
Swaziland	389	10	6
Tanzania	157	23	7
Uganda	408	8	4
Zambia	116	5	9
Zimbabwe	119	68	
	721		

Source: UN Comtrade; FAOSTAT

Namibia and Sudan, are only countries on this list with a percentage commercial export risk exposure greater than 10 percent, if exports of all "possibly" GM were suddenly lost. Namibia's exposure is high because of its exports of live cattle, sheep and goats, and beef, veal, and mutton. Namibia's total maize product exports totaled only $2 million in 2003, only a trivial share of total agricultural exports. Sudan's export risk exposure is also exaggerated a bit by the inclusion of all animal and meat products as "possibly GM." In 2003 Sudan exported $5 million worth of camels and $123 million worth of sheep, neither being products likely to be rejected in international trade if raised, somehow, on GM feed. Sudan's total maize exports in 2003 equalled only $2 million.

In terms of dollar value of possibly GM exports, excluding Namibia and Sudan the top ranking countries on this list are Egypt and Zimbabwe. Egypt might have lost $80 million in export sales in 2003 if all customers had stopped buying all of its "possibly GM" products. The bulk of these exports consisted of potato ($44 million), dairy products ($24 million), and meat the live animals ($11 million). Since GM potatoes are no longer being grown even in the United States, and since meat and dairy products are again of secondary sensitivity, compared to products with actual GM content like maize and soy products, the degree of commercial export risk is again possibly an exaggeration. In the case of Zimbabwe, animal products again play a large role.

The commercial export risks Africa would face if it allowed the planting of GM appear even smaller when we consider the export destinations of most of the "possibly GM" products sent abroad by African countries. Not all export destinations are equally sensitive to the possible GM content of food and feed products. The highest risks of losing export sales due to consumer resistance or regulatory restriction are found in Europe. Risks may be encountered in Asia and in the Arab world as well. For most countries in Africa, fortunately, the vast majority of "possibly GM" exports currently go not to Europe, not to Asia, and not to the Arab world, but to other (non-Arab) countries in Africa. Table 2 provides export destination percentages for "possibly GM" products from eleven of the COMESA countries considered above.

Table 2: Percentage of "Possibly GM" exports to various destinations for a selection of African countries, 2003

	Europe	Asia	Arab World	Non-Arab Africa	Rest of World

Burundi	58	0	42	0	0
Comoros	13	0	0	60	27
Egypt	47	0	49	2	1
Ethiopia	0	0	96	0	4
Kenya	0	1	15	80	4
Madagascar	17	15	14	9	44
Malawi	0	0	0	99	0
Mauritius	55	0	5	8	32
Tanzania	6	2	3	85	4
Uganda	0	0	0	99	0
Zambia	4	0	0	95	0

Source: UN Comtrade

Table 2 reveals that by far the most frequent export destination for "possibly GM" products from these selected African countries was other (non-Arab) African countries. Europe or the Arab world were primary export destinations only for Burundi, Egypt, Ethiopia, and Mauritius, and Asia was a primary export destination of possibly GM products for none of these countries.

By combining information contained in these two tables, we can provide in Table 3 an even more refined commercial export risk measurement, a percentage measure of the share of total agricultural exports that are *both* "possibly GM" and going to a highly GM-sensitive destination, such as Europe, Asia, or the Arab world:

Table 3: Percentage of Agricultural Exports "Possibly GM" and Going to a Highly GM-Sensitive Destination, 2003

Burundi	0
Comoros	0
Egypt	9
Ethiopia	2
Kenya	0
Madagascar	0
Malawi	0
Mauritius	3
Tanzania	0
Uganda	0
Zambia	0

Except perhaps for Egypt the commercial export risks described by these percentages are vanishingly small.

Table 2 reveals that most African exports of "potentially GM" products go to other African countries. This will present a problem only if those countries fail to agree on a system for accepting the movement of products such as GM maize, or animals fed with GM maize, across national borders. Following the food aid controversy of 2002, governments in eastern and southern Africa felt a need to harmonize their policies toward 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 create a regional policy toward GMOs, including GMOs as food aid.

Constructing a truly "regional" policy approach will be a challenge. The prevailing approach has been to treat GMO policy as an independent sovereign choice to be made separately within national political systems. For emergency food aid, this state-by-state approach has been explicitly endorsed by SADC and accepted by the WFP. For commercial imports of GM products the sate sovereignty approach is implicitly endorsed by the Cartagena Biosafety Protocol and also by the AU African Model Law. Still, states might use this sovereignty to negotiate regional agreements that would harmonize policies, or agreements to mutually recognize and honor the policies of other states.

Even in commercial terms, then, the export risks that governments in Africa might face by allowing their farmers to grow GM crops seem trivial relative to the probable benefits in terms of higher productivity and higher income for farmers, greater food security. Moreover, it is within the power of African governments to lessen these small risks still more by agreeing among themselves on harmonized systems for allowing "potentially GM exports" to be sold internally within Africa, without stigma or restraint.

The Future of GM Crops in Africa

Until now it has been relatively easy for critics of GM crops to dismiss their potential in Africa, because the private international companies that took the early lead in developing these crops concentrated their efforts on products – such as soybeans – grown by wealthy commercial farmers in the Temperate Zone rather than on products – such as sorghum, cowpeas, or cassava – 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, yet not all the time. One example is a current 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 have transferred these genes into agricultural crop plants such as soybean, rice, and maize, with exciting results in early greenhouse and field trials. If these DT traits can be transferred to tropical varieties of Maize they could offer poor African farmers something even more valuable than the insect resistance traits of *Bt* crops. DT crops would give small farmers in Africa – and also in the drylands of South Asia – a safety-net against the cyclical food crises that afflict these regions regularly whenever rains fail. The 2001-02 drought in Southern Africa put 15 million people at risk and required a massive international food aid response. An earlier drought in 1991-92 had been even more severe, putting 18 million people – many of them poor maize farmers – at a food security risk.

A next generation of DT crops might begin to provide for Africa something close to the "uniquely African Green Revolution" that Kofi Annan has called for. To open the way for that possibility, governments in Africa must begin to see the supposed risks of allowing GM crops to be planted in a more complete perspective.