who benefits from gm crops?

feeding the biotech giants, not the world's poor

february 2009 | issue 116

Friends of the Earth International

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friends of the earth international is the world's largest grassroots environmental network, uniting 77 diverse national member groups and some 5,000 local activist groups on every continent. With approximately 2 million members and supporters around the world, we campaign on today's most urgent social and environmental issues. We challenge the current model of economic and corporate globalization, and promote solutions that will help to create environmentally sustainable and socially just societies.

our vision is of a peaceful and sustainable world based on societies living in harmony with nature. We envision a society of interdependent people living in dignity, wholeness and fulfilment in which equity and human and peoples' rights are realized.

This will be a society built upon peoples' sovereignty and participation. It will be founded on social, economic, gender and environmental justice and free from all forms of domination and exploitation, such as neoliberalism, corporate globalization, neo-colonialism and militarism.

We believe that our children's future will be better because of what we do.

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The biotechnology industry has aggressively touted GM as a solution to hunger and the global food crisis.[1] Their arguments have been accepted by many politicians.[2] This Friends of the Earth International (FoEI) report looks behind the spin and exposes the reasons why GM crops cannot, and are unlikely to ever, contribute to poverty reduction, global food security or sustainable farming:[3]

- *Firstly, hunger is chiefly attributable to poverty, not to a lack of food production. For small farmers, this means a lack of access to credit, land, inputs and technical support as well as declining investment in agriculture by governments. For urban dwellers, it means not having enough money to purchase increasingly expensive food.*
- *Secondly, the vast majority of GM crops are not grown by, or destined for, the world's poor. They are used for animal feed, biofuels, or highly processed food products in rich countries. Most commercial GM crops are grown by large farmers in a handful of countries (Brazil, Argentina and the US) with industrialised, export-oriented agricultural sectors.*
- *Thirdly, it is widely accepted that GM crops do not increase yield, and in some cases yield less than conventional crops.*
- *Fourthly, official data from major producer countries – US, Argentina and Brazil – confirms that pesticide use increases with GM crops, including the use of toxic chemicals banned in some European countries. This raises costs for farmers and also causes agronomic, environmental and health problems, mostly affecting poor communities who live near intensive GM farms.*
- *Fifthly, the real beneficiaries of the GM system are biotech companies which profit from patents, expensive GM seeds, and increased pesticide sales. Poor farmers in contrast are squeezed by escalating costs.*

gm crops: what is grown?

GM crops on the market incorporate essentially just two "traits" – herbicide tolerance and/or insect resistance. Insect-resistant or Bt cotton and corn produce their own built-in insecticide derived from a soil bacterium, *Bacillus thuriengiensis (Bt)*, to protect against certain (but far from all) insect pests. Herbicide-tolerant crops are engineered to withstand direct application of an herbicide to more conveniently kill nearby weeds. Crops with herbicide tolerance predominate, occupying 82% of global biotech crop acreage in 2007.

Despite the GM hype built up by the industry during the food crisis, there is still not a single commercial GM crop with increased yield, drought-tolerance, salt-tolerance, enhanced nutrition or any of the other 'beneficial' traits long-promised by the industry. Disease-resistant GM crops are practically non-existent, and are grown on a tiny scale.

what is the status of gm crops in the world today?

First introduced 15 years ago, GM crops are still confined to a handful of countries with highly industrialised, export-oriented agricultural sectors. Nearly 90% of the area planted to GM crops in 2007 was found in just six countries in North & South America, with 80% in the US, Argentina and Brazil. One country alone, the United States, plants over 50% of the world's GM crops. Less than 3% of cropland in India and China is planted with GM crops, almost exclusively GM cotton.[4] In the 27 countries of the European Union, GM crop cultivation represents a mere 0.21% of agricultural land.

Soybeans.

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Cotton farmer, India.

executive summary

continued

exposing *who* does *benefit* in times of "food crisis"

The global food crisis has already pushed the number of hungry and poor to 1 billion[5] but agribusiness corporations[6] have increased their profits hugely during the same period. The Monsanto Company is particularly well-positioned to profit from the food crisis. Monsanto is the world's largest seed firm, holds a near monopoly in the biotech "traits" incorporated in GM seeds, and markets Roundup, the world's biggest selling pesticide. Thus, Monsanto is expected to increase its total revenue by a substantial 74% from 2007 to 2010 (from \$8.6 to \$14.9 billion). The corporation's net income (after tax) has been projected to triple over the same period, from \$984 million to \$2.96 billion.[7]

This is because as agricultural commodity prices have spiralled upwards, big farmers growing export crops like GM soy and maize for international markets have been receiving more for their crops. This has allowed Monsanto and other companies to raise seed and pesticide prices exponentially, ensuring that farmers who have long suffered from low world prices for their crops do not benefit from any price rises. However, price increases began even before the sharp rise in agricultural commodity prices. This is part of an aggressive profit-maximizing "trait penetration" strategy whereby Monsanto rapidly phases out more affordable seed varieties in favour of new GM seeds with an increasing number and the latest generation of traits, and corresponding increases in seed prices.

gm seed price increase: no end in sight

In the US the average price of soybean seed has increased more than 50% over the last two years, and further increases are expected as Monsanto rolls out a new more costly version of their patented 'Roundup Ready'[8] soybeans (called RoundUp Ready 2) in 2009. At the quoted prices, the increased cost for US soybean farmers who replace just 50% of original RR with RR2Y soybeans would come to a substantial \$788 million, much of which will accrue to Monsanto.

Bt Corn field, Nebraska.

Meanwhile, US farmers report increasing difficulties finding quality conventional (non-GM) soybeans.[9]

Monsanto is also substantially raising the prices for all types of its GM corn seed – whether single-trait, double-trait or so-called triple-stack corn.[10] The price of Monsanto's triple-stack corn will reportedly increase by \$95-100 per bag, to top \$300 per bag in 2009 (Guerbert, 2008). The company has also raised its trait prices for its less expensive single and double-stack corn seed more sharply than for triple-stack corn in order to "move as many customers to triple stacks as possible," creating "a captive customer base for the 2010 launch of its SmartStax octo-stack product."[11]

pesticide price hike

Retail prices in the US for Roundup have increased by 134% in less than two years. Monsanto controls roughly 60% of the market for glyphosate (the active ingredient of Roundup), which in 2006 was estimated at \$3.8 billion.[11] This means about \$2.3 billion in 2006 sales revenue from Roundup. The 134% retail price hike since late 2006 is likely to bring Monsanto hundreds of millions of dollars in additional revenue from its flagship herbicide.[12]

In Argentina, by the end of 2007, increased agrochemical demand[13] coincided with rising glyphosate prices, which have climbed substantially in comparison to the prices of herbicides used on conventional crops.

Monsanto is also driving greater use of Roundup by incorporating the Roundup Ready trait in nearly every GM seed it sells. US farmers who once bought GM maize modified only to be resistant to insect pests (Bt crops) now find these varieties "stacked" with the Roundup Ready herbicide resistance trait as well. As a result, in the US , the area planted with Monsanto GM maize seed without the Roundup Ready trait fell dramatically from 25.3 million acres in 2004 to just 4.9 million acres in 2008. This "trait penetration" strategy means higher profits from both seeds and Roundup sales, and ensures farmers' dependence on GM traits and Roundup.

Corn harvest, Africa.

gm crops increase pesticide use

Over a decade of experience in the US, Argentina and Brazil demonstrates that GM crops have contributed substantially to rising pesticide use and an epidemic of herbicide-resistant weeds. Resistant weeds have prompted biotechnology firms to develop new GM crops that tolerate heavier applications of chemicals, and tolerate two herbicides rather than just one, promoting pesticide use even further. The use of mechanical tillage to control resistant weeds is also increasing, contributing to greater soil erosion and global warming gas emissions.

In the US, when GM crops were first grown, the rising use of glyphosate on Roundup Ready crops was more than offset by reductions in the use of other pesticides. As of 2000, however, weeds that could no longer be controlled with the normal dose of glyphosate began to emerge, driving farmers to apply more. Thus, the widespread adoption of Roundup Ready crops combined with the emergence of glyphosate-resistant weeds has driven a more than 15-fold increase in the use of glyphosate on major field crops from 1994 to 2005. The trend continues. In 2006, the last year for which data is available, glyphosate use on soybeans jumped a substantial 28%, from 75,743 million lbs in 2005 to 96,725 million lbs in 2006.[14]

More and more farmers are being told – by agronomists and by Monsanto[15] - to combat glyphosate-resistant weeds by applying other chemicals, such as paraquat, diquat and atrazine, often in combination with higher rates of glyphosate.[16] USDA pesticide data confirm this trend: rising glyphosate use even while use of other more toxic herbicides also increases, or at best remains constant.

In Argentina, overall glyphosate use has more than tripled from 65.5 million litres in 1999/2000 to over 200 million litres in 2005/6.[17] In 2007, agricultural experts reported that a glyphosate-resistant version of Johnsongrass *(Sorghum halapense)* was infesting over 120,000 ha of the country's prime cropland. Johnsongrass, an extremely damaging perennial, is a monocot weed that is considered one of the worst weeds in the world, and resistance to glyphosate will make it all the more harder to control.

The emergence of glyphosate-resistant Johnsongrass is directly attributable to the huge increase in glyphosate use associated with near total dependence on Roundup Ready soybeans in Argentina. The main recommendation to control resistant weeds is to use a cocktail of herbicides other than glyphosate, including more toxic weedkillers such as paraquat, diquat and triazine herbicides such as atrazine.[18] It is estimated that an additional 25 million litres of herbicides will be needed each year to control resistant weeds, resulting in an increase in production costs of between $160 and $950 million per year.[19]

In Brazil, government agencies show that the consumption of the main active ingredients in the most heavily used soya herbicides increased by 60% from 2000 to 2005. Use of glyphosate grew 79.6% during this period, much faster than the increase in area planted to Roundup Ready soya.[20]

Several factors make it virtually certain that the number of weeds resistant to glyphosate and their prevalence will continue to rise dramatically in the future. These factors include: 1) More planting of glyphosate-tolerant crops in rotation (every year) 2) Continuing dramatic increases in the use of glyphosate; 3) New glyphosate-tolerant crops on the horizon, including some that are engineered to withstand higher doses of glyphosate. As a result, overall use of toxic weedkillers to kill increasingly resistance weeds is bound to increase, with adverse effects on human health (especially farmworkers) and the environment.

do gm crops increase yield?

None of the GM crops on the market are modified for increased yield potential. Corporations' research and product pipelines continue to focus on new pesticide-promoting varieties that tolerate the application of one or more herbicides. For instance, of the 14 GM crops awaiting USDA commercial approval, nearly half (6) are herbicide-tolerant: corn, soybeans, cotton (2), alfalfa and creeping bentgrass (for golfcourses). None of the others represent beneficial new traits. Corn and cotton with insect-resistance are minor variations on existing IR crops. Virus-resistant papaya and soybeans with altered oil content are already approved, though not grown to any significant extent. Carnations engineered for altered colour are a trivial application of biotechnology. One GM corn is engineered for sterile pollen, while another engineered to contain a novel enzyme for "self-processing" into ethanol presents potential risks to human health.

The US Department of Agriculture (USDA) admits that genetic engineering has not increased the yield potential of any commercialised GM crop.[21] In 2001, University of Nebraska agronomists attributed a six per cent yield drag directly to unintended effects of the genetic modification process used to create the Roundup Ready soybean.[22] Yield-lowering effects of this sort are a serious, though little-acknowledged, technical obstacle to genetic engineering, and are one of several factors foiling efforts to develop viable GM crops with drought-tolerance, disease-resistance and other traits.[23]

A six per cent yield drag corresponds to the substantial loss in production of 160 lbs/acre. By one estimate, this drag on soybean yields cost US soybean farmers $1.28 billion in lost revenues from 1995 to 2003.[24]

executive summary

continued

The largest global assessment of agricultural science (IAASTD)[25], endorsed by 58 governments, corroborated this, concluding that: "The application of modern biotechnology outside containment, such as the use of GM crops is much more contentious. For example, data based on some years and some GM crops indicate highly variable 10-33% yield gains in some places and yield declines in others" (Synthesis Report summary, p.14) and that: "The impacts of transgenic plants, animals and microorganisms are currently less understood. This situation calls for broad stakeholder participation in decision making as well as more public domain research on potential risks" (Global Summary, p. 20).

why do some farmers still grow gm crops?

Herbicide-tolerant crops (mainly soybeans) are popular with larger growers because they simplify and reduce the need for labour for weed control (Duffy, 2001). This labour-saving effect explains the appeal of the world's most widely planted GM crop, Roundup Ready soybeans, which have facilitated the worldwide trend to concentrate farmland in fewer, ever bigger, farms[26] putting small farmers out of business and creating rural unemployment and poverty. This confirms the attraction of GM crops for large farms and landowners who target export markets.

Why do farmers grow GM herbicide-tolerant soybeans if they don't deliver increased yield and/or income? For some, reduced yields are accepted as the price to be paid for simplification and labour-saving in weed management, which are especially attractive to larger growers. There are, however, increasing cases in the US where farmers would prefer to grow non-GM crops but find it increasingly difficult to find high-quality conventional seeds.

According to the Argentine Sub-Secretary of Agriculture, this labour-saving effect means that only one new job is created for every 1,235 acres of land converted to soybeans. The same amount of land, devoted to conventional food crops on moderate-size family farms, supports four to five families and employs at least half a dozen people.[27]

conclusion

We are facing an unprecedented crisis in the global food system with rising numbers of hungry people in the world, even though we produce more than enough food to feed the world. Meanwhile, increasing control of the world's seed supply by biotech companies enables them to garner record profits, even as millions are starving. Clearly, we need a fundamental shift in food and agriculture policy. Our goals should be to ensure fair access to land, credit and training to help the world's small farmers (who comprise more than 2/3 of the world's most poor and hungry) produce more to feed themselves and their communities, and to ensure that the world's urban poor have access to affordable food.

The GM farming model will not achieve these goals. GM crops mean extremely costly seeds and increasing use of expensive chemicals, both of which are well beyond the means of most small farmers in developing countries. The model of GM farming favors larger, wealthier farmers, and will deepen their dependence on high energy and resource use at a time of rising climate emissions and resource depletion. This is not how poverty, hunger and the food crisis are going to be solved.

The most promising means to achieve these goals were laid out by the first International Assessment of Agricultural Science and Technology for Development (IAASTD), a four-year effort sponsored by the United Nations and World Bank. The IAASTD, which involved 400 experts from 58 countries, released its preliminary report in the spring of 2008. This exhaustive analysis by experts from many disciplines found that the best way to fight global hunger was by returning to ecologically sound, low-input, low-cost farming methods.[28] The same study found that GM crops offered very little potential for alleviating poverty and hunger, which helps explain why several biotech companies withdrew from the study.

The approaches favoured by IAASTD included agro-ecological farming techniques, looking at the wider benefits of agriculture in terms of ecosystems, landscapes and culture. Local knowledge was promoted as crucial for developing appropriate farming methods. The report also urged a reduction in agricultural subsidies in rich nations and reform of unfair trade rules. Together these could provide a way of developing sustainable agriculture, including wider employment opportunities, enhanced rural livelihoods and ultimately greater yields, reducing hunger and poverty.

Left: Bayer Crop Science, Monsanto sign, Paraguay.
Right: Soy field in the agricultural area of Londrina, in the state of Parana, Brazil.

introduction: ISAAA's inflated figures

Every year, the International Service for the Acquisition of Agri-Biotech Applications (ISAAA) publishes figures on the cultivation of genetically modified (GM) crops around the world. Funded largely by the biotech industry, the ISAAA figures are frequently inflated and poorly referenced, if at all. In last year's report, for example, the ISAAA more than doubled the increase in GM crops worldwide to 22% by multiplying the actual surface area by the number of GM traits in the crops. So, for a field of one hectare growing a GM crop which is tolerant to two herbicides and secretes insecticide toxin (three traits) suddenly becomes three fields, and ISAAA therefore triples its figures for the area under GM crop cultivation.[29]

The ISAAA justifies this inflation of the figures as "more accurate[ly] account[ing]" for the use of different types of GM crops. This rather desperate and nonsensical approach is most likely because the area under crop cultivation worldwide, 114.3 million hectares, is a mere 2.4% of global agricultural land and because key markets like the European Union have resoundingly rejected GM foods. The ISAAA report is a PR strategy to pressure governments, and to convince investors, that GM crops are a success.

Each year, Friends of the Earth International publishes a nuanced, fully-referenced, fact-based assessment of GM crops around the world, designed to clear up common misconceptions about their nature and impacts. In this 2009 edition, we report on new trends and findings, particularly the failure to tackle hunger or solve the food crisis with GM crops. We also address the rise in pesticide use and lack of yield increase which is now widely observed with GM crops, and we provide an overview of the continuing failure of GM crops in Europe.

Spraying fields.

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one feeding the world's poor? who benefits in times of "food crisis"?

feeding the world's poor? who benefits in times of "food crisis"?

Rising global food prices reached a flash point in the spring of 2008, sparking food riots in over a dozen countries. Haiti's prime minister was ousted amid rice riots; Mexican tortillas quadrupled in price. African countries were especially hard hit (The Guardian, 2008). According to the World Bank, global food prices rose a shocking 83% from 2005 to 2008 (World Bank, 2008). And for the world's poor, high prices mean hunger. In fact, the food crisis recently prompted University of Minnesota food experts to double their projection of the number of the world's hungry by the year 2025 – from 625 million to 1.2 billion (Runge et al. 2007).

While the financial crisis has caused prices to drop a little, they still remain high and are still of concern to the international community. Most recently the Food and Agriculture Organisation (FAO) organised a summit on the issue in Madrid, which took place at the beginning of 2009.

The global food crisis has many causes, but according to the biotechnology industry there's a simple solution – GM crops (Reuters, 2008). Yet if biotech companies are crucial to feeding the world, one might fairly ask why more and more people are going hungry even as adoption of GM crops continues to rise.

GM crops are not the answer to world hunger for three major reasons. Firstly, hunger is chiefly attributable to poverty. For small farmers, this means a lack of access to credit, land, inputs and technical support. For urban dwellers, it means not having enough money to purchase increasingly expensive food. Secondly, the vast majority of GM crops are not grown by, or destined for, the world's poor. Instead, they are used for animal feed, biofuels, or highly processed food products in rich countries. Finally, GM crops do not yield more than conventional crops, and in some cases yield less. These facts suggest that GM crops have not increased food security for the world's poor. As explained below, the true beneficiaries of this technology are a handful of huge agrichemical and seed companies, which profit from selling more expensive GM seeds, rising pesticide use, and from the hype surrounding their endless, unfulfilled promises.

Rice affected by price rise.

1.1 animal feed and export markets

The vast majority of commercial GM crops are grown by large farmers in a handful of countries with industrialised, export-oriented agricultural sectors. Nearly 90% of the world's biotech acres in 2007 were found in just six countries of North and South America, with the U.S, Argentina and Brazil accounting for 80% (See Table 1 below). GM soybeans are dominant in South America, Argentina and Brazil are known for some of the largest soybean plantations in the world. In most other countries, including India and China, biotech crops (mainly GM cotton) account for three per cent or less of total harvested crop area (FoEI, 2008). Despite GM field tests with 150 plant species, biotech versions of just four crops – soybeans, corn, cotton and canola – comprise virtually 100% of world biotech crop acreage (See Table 2, Chapter 1), the same four GM crops that were being grown a decade ago. Soybeans and corn predominate, and are used mainly to feed animals or fuel cars in rich nations. Argentina, Brazil and Paraguay export the great majority of their soybeans as livestock feed, mainly to Europe and Japan (FoEI, 2008), while more than three-quarters of the US corn crop is either fed to animals or used to generate ethanol for automobiles. Dr. Charles Benbrook, a leading US agricultural scientist, says expanding GM soybean monocultures in South America are displacing small farmers who grow food crops for local consumption, contributing to food insecurity. In Argentina, production of potatoes, beans, beef, poultry, pork and milk have all fallen with rising GM soybean production, while hunger and poverty have increased (Benbrook, 2005). In Paraguay, poverty increased from 33% to 39% of the population from 2000 to 2005, the years in which huge soybean plantations (about 90% of them now GM soybeans) expanded to cover over half of Paraguay's total cropland (FoEI, 2008). The only other commercial GM crops are papaya and squash, both grown on miniscule acreage, and only in the US.

It is also important to consider what biotech companies have engineered these crops for. Hype notwithstanding, there is not a single commercial GM crop with increased yield, drought-tolerance, salt-tolerance, enhanced nutrition or other attractive-sounding traits touted by the industry. Disease-resistant GM crops are practically non-existent.

GM crops on the market incorporate essentially just two "traits" – herbicide tolerance and/or insect resistance. Insect-resistant or Bt cotton and corn produce their own built-in insecticide derived from a soil bacterium, Bacillus thuriengiensis (Bt), to protect against certain (but far from all) insect pests. Herbicide-tolerant crops are engineered to withstand the direct application of a herbicide to more conveniently kill nearby weeds. Crops with herbicide tolerance predominate, occupying 82% of global biotech crop acreage in 2007 (See Chapter 2).

Herbicide-tolerant crops (mainly soybeans) are popular with large growers because they simplify and reduce labour requirements for weed control (Duffy, 2001). This labour-saving effect explains the appeal of the world's most widely planted GM crop, Roundup Ready soybeans, which have facilitated the worldwide trend to concentrate farmland in fewer, ever bigger farms (Roberson, R. 2006). A striking confirmation of this is provided by Gustavo Grobocopatel, who farms 200,000 acres of soybeans in Argentina (an area the size of New York City), making him one of the world's largest soybean growers. Even though Grobocopatel obtains consistently higher yields with conventional soybeans, he prefers to plant Monsanto's herbicide-tolerant variety (Roundup Ready) for the sake of saving labour. According to the Argentine Sub-Secretary of Agriculture, this labour-saving effect means that only one new job is created for every 1,235 acres of land converted to soybeans (Benbrook, 2005). This same amount of land, devoted to conventional food crops on moderate-sized family farms, supports four to five families and employs at least half a dozen people (Benbrook, 2005). Small wonder that family farmers are disappearing and food security is declining. The rapid expansion of "labour-saving" GM soybeans in South America has led to "agricultura sin agricultores" ("farming without farmers") (Giardini, H. 2006).

TABLE 1 TOP PRODUCERS AND EXPORTERS OF SOYBEAN IN THE WORLD 2007/08 (000 MT)

COUNTRIES	2006/07 PRODUCTION IN 000 MT	2007/08 PRODUCTION IN 000 MT	EXPORTS OF SOYBEAN IN THE WORLD 2007/08 SOYBEAN	SOY MEAL	SOY OIL
US	86,770	70,358	31,162	8,618	1,429
Brazil	59,000	61,000	25,200	13,600	2,450
Argentina	47,200	47,000	12,200	27,567	6,000
China	16,200	13,500	-	-	-
India	7,690	9,300	-	4,310	-
Paraguay	6,200	6,800	4,360	1,715	400
Canada	3,460	2,700	1,720	-	-
Other nations	9,253	8,138	1,553	2,391	> 900
Total	**235,773**	**218,796**	**70,682**	**58,201**	**11,254**

Source: *Friends of the Earth International, 2008, Based on data from USDA, July 2008. Oilseeds: World Markets and Trade.*

1.2 profiting from the food crisis

Between 2007 and 2008, the average price of food crops rose dramatically – corn by 60%, soybeans by 76%, wheat by 54%, and rice by 104% (Runge & Senauer, 2008). The World Bank predicts that extraordinarily high grain prices will persist for at least the next five years, declining somewhat – to levels still above 2007 prices – only by 2015 (World Bank, 2008). According to World Bank president Robert Zoellick, these huge grain price hikes have already pushed 100 million more people into hunger and poverty (Runge & Senauer, 2008). They have also provided the perfect opportunity for biotech companies like Monsanto to cash in on the food crisis.

box 2 Miguel D'Escoto Brockmann, President of the General Assembly of the United Nations, September 2008

"The essential purpose of food, which is to nourish people, has been subordinated to the economic aims of a handful of multinational corporations that monopolize all aspects of food production, from seeds to major distribution chains, and they have been the prime beneficiaries of the world crisis. A look at the figures for 2007, when the world food crisis began, shows that corporations such as Monsanto and Cargill, which control the cereals market, saw their profits increase by 45 and 60 per cent, respectively; the leading chemical fertilizer companies such as Mosaic Corporation, a subsidiary of Cargill, doubled their profits in a single year".

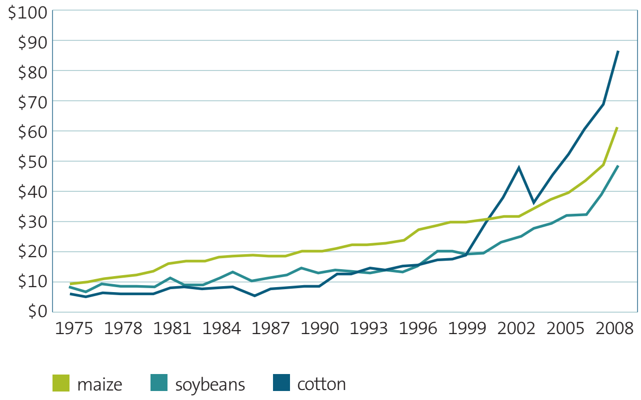
With farmers in major exporting nations like the US receiving more for their crops, companies that sell seeds, agricultural chemicals and other "inputs" can charge farmers correspondingly more for these supplies. This means that hard-pressed farmers, who have long suffered from low grain prices, are not benefiting now that prices for their crops have increased – especially with the cost of fertilisers and fuel also increasing. Monsanto, however, is perfectly positioned to profit. It is the world's largest seed firm, holds a near monopoly in the market for biotech traits incorporated in GM seeds (FoEI, 2008), and also markets Roundup, the world's biggest-selling pesticide. It is little wonder that Goldman Sachs recently projected Monsanto's total revenue as increasing by a substantial 74% from 2007 to 2010 (from $8.6 to $14.9 billion). Still more dramatic, Monsanto's net income (after tax) was projected to triple over the same period, from $984 million to $2.96 billion (Goldman Sachs, 2008).

one feeding the world's poor? who benefits in times of "food crisis"?

continued

Monsanto is profiting from the food crisis in several ways. Firstly, the company has been raising its seed and trait prices for several years now. Figure 2 contains USDA data on the average cost of seeds sold to US farmers for the three major biotech crops – soybeans, corn and cotton. Monsanto's dominance in all three crops[30] means that its pricing structure is largely responsible for these rising prices. The average soybean seed price in the US has risen by more than 50% in just two years from 2006 to 2008 – from $32.30 to $49.23 per planted acre. Soybean seed prices are expected to continue to rise dramatically in the coming years as Monsanto rolls out a new more costly version of its old staple, Roundup Ready (RR) soybeans, in 2009. According to one early report, the new Roundup Ready 2 Yield (RR2Y) soybean seeds will cost farmers $78 per planted acre, nearly 50% more than original RR soybeans ($53/acre) (OSU, 2008). Soybeans are grown on roughly 70 million acres in the US, and over 90% or 63 million acres are Roundup Ready ones. In the coming years, Monsanto will gradually replace RR with RR2Y. At the quoted prices, the increased cost to soybean farmers from replacing just 50% of original RR with RR2Y soybeans would come to a substantial $788 million (½ * $25/acre (78-53) * 63 million acres), much of which will accrue to Monsanto. Meanwhile, farmers report increasing difficulties finding quality conventional (non-GM) soybeans (Roseboro, 2008).

FIGURE 1 AVERAGE COST OF MAIZE, SOYBEAN AND COTTON SEED IN THE US: 1975 - 2008 ($ PER PLANTED ACRE)



Source: *USDA Economic Research Service: Commodity Costs and Returns: US and Regional Cost and Return Data. 1975-2007 datasets accessible at: http://www.ers.usda.gov/Data/CostsAndReturns/testpick.htm. The 2008 figures are forecasts, made in November of 2008, available at: www.ers.usda.gov/Data/CostsAndReturns/data/Forecast/cop_forecast%20.xls (downloaded 21/12/08).*

Corn and cotton seed prices have risen almost as quickly as soybeans – more than 50% in the three years from 2005 to 2008 (See Figure 1). Further dramatic increases in corn seed prices are in the offing. Monsanto is substantially raising the prices for all types of its GM corn seed – whether single-trait, double-trait or so-called triple-stack corn.[31] The price of Monsanto's triple-stack corn will reportedly increase by $95-100 per bag, to top $300 per bag in 2009 (Guerbert. 2008). At typical corn seeding rates, $300 per bag of corn translates to roughly $100 per planted acre, and the $100 per bag price rise to an additional $30 per acre. With 29.4 million acres planted with Monsanto's triple-stack corn in 2008 (Monsanto, 2008a), US farmers could be seeing well over half a billion dollars in increased triple-stack corn seed costs in 2009. Interestingly, the company is raising its trait prices for its less expensive single- and double-stack corn seed more sharply than for triple-stack corn in order to "move as many customers to triple-stacks as possible…" and to "create a captive customer base for the 2010 launch of its SmartStax octo-stack product." (Goldman Sachs, 2008).

This is a good illustration of Monsanto's profit-maximising "trait penetration" strategy that we discussed in the last edition of Who Benefits from GM Crops? The "octo-stack" product refers to GM corn with eight different traits (six insecticides and tolerance to two different herbicides) being developed by Monsanto and Dow. Since the price of GM seed ratchets up with each additional trait that is introduced, the price for SmartStax will be astronomical, and farmers who want more affordable conventional seed, or biotech seed with one or two or even three traits, may soon be out of luck. Tennessee farmer Harris Amour predicts that double and triple-stack GM corn seeds will be discontinued once the eight-trait corn is introduced: "I like to buy what I want. When they start stacking for things I don't need, it just makes the price of the seed go up." (Roberts, 2008) University of Kentucky's Chad Lee is one of many agronomists who are concerned: "The cost of corn seed keeps getting higher and there doesn't appear to be a stopping point in sight" (Lee, 2004).

Not content with increased profits from these dramatic seed price hikes, Monsanto is also raising the price of its Roundup herbicide. Retail prices for Roundup have increased from just $32 per gallon in December 2006 to $45 per gallon a year later, to $75 per gallon by June 2008 – a 134% price hike in less than two years. Monsanto controls roughly 60% of the market for glyphosate (the active ingredient of Roundup), which in 2006 was estimated at $3.8 billion (Goldman Sachs, 2008). This means about $2.3 billion in 2006 sales revenue from Roundup. The 134% retail price hike since late 2006 is expected to bring Monsanto hundreds of millions of dollars in additional revenue from its flagship herbicide.[32]

This increase in Roundup prices should be seen in conjunction with Monsanto's trait penetration strategy, which is focused on the Roundup Ready trait. Monsanto now profits three times from every sale of seed bearing the RR trait: once from the seed price premium for the RR trait, a second time from increased sales of Roundup that is used with the seed, and now a third time through the spike in Roundup prices. This explains Monsanto's aggressive push to incorporate the Roundup Ready trait in practically every GM seeds it sells.[33]

For instance, world acreage planted to Monsanto GM corn seed that does NOT incorporate the RR trait[34] peaked at 29.6 million acres in 2004, and has since fallen by half (15 million acres in 2008). In the US, which sets the trends for GM crops worldwide, the change is even more pronounced: from 25.3 million acres in 2004 to just 4.9 million acres in 2008. Over the same period, Monsanto dramatically increased worldwide sales of GM corn varieties with the RR trait, from 17.4 million acres (2004) to 72.6 million acres (2008). This trait penetration strategy is also reflected in the near-tripling of the percentage of biotech crop area planted to "stacked" crops incorporating two or more traits from 1999 (7%) to 2007 (19%) (ISAAA). Farmers who would prefer to purchase GM seed with the insect-resistance trait(s) alone find themselves forced to buy seeds that also contain the RR trait.

Much of Monsanto's increased revenue is being used to buy up the competition. In 2008, the company spent $863 million acquiring the Netherlands-based De Ruiter Seeds Group BV, a purchase which reportedly gives the company a 25% share of the $3 billion vegetable seed market (Leonard, 2008). Monsanto is also increasing its control of the corn seed market, both in the US and abroad. In the US, it increased its market share in corn seeds from 43% in 2001 to 61% in 2008, largely through its aggressive acquisition of 25 US regional seed firms since 2004, which are held by its American Seeds, Inc. subsidiary (Goldman Sachs, 2008). In June 2008, it also announced its acquisition of Guatemala-based Semillas Cristiani Burkard, the leading Central American corn-seed company, with a long-term strategy of introducing its GM corn to Central and Latin America, the birthplace of maize (Monsanto, 2008b).

Monsanto's growing control of the world's seed supply gives it even greater power to incorporate its traits into ever more seed varieties, and to withdraw conventional seeds from the marketplace. As a result, farmers in any country that welcomes Monsanto can expect to suffer the same fate as US farmers – dramatically increasing seed prices, a plethora of expensive but unwanted "traits", and a radical decline in the availability of high-quality conventional seeds.

box 3 deserting the hungry?

The UN and World Bank recently issued the first scientific assessment of world agriculture, which concluded that GM crops have very little potential to alleviate poverty and hunger. This four-year effort, called the International Assessment of Agricultural Science and Technology for Development (IAASTD), engaged 400 experts from industry, government, academia and the public interest community to chart out the most promising paths for poor countries to increase their food security (The Guardian, 2008). Interestingly, several biotech companies pulled out of the process just months prior to its completion, upset by the poor marks given to their favorite technology. In response, the leading science journal Nature chided the companies in an editorial entitled "Deserting the Hungry?" (Nature, 2008).

1.3 gm crops and yield

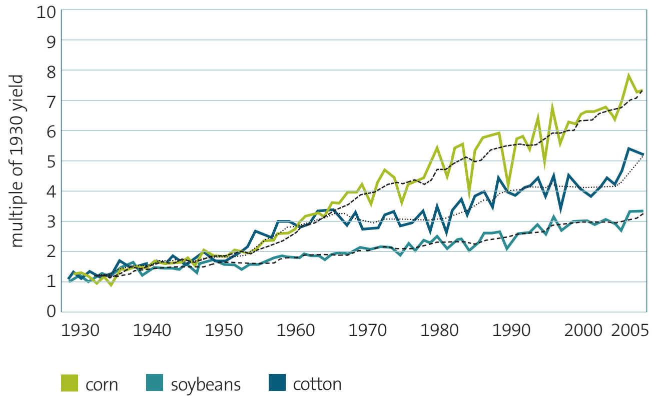
Yield is a complex phenomena that depends on numerous factors, including weather, the availability of irrigation and fertilisers, soil quality, farmers' management skills, and levels of pest infestation. Genetic improvements achieved through conventional (i.e. non-biotech) breeding are also important. None of the GM crops on the market are modified for increased yield potential. As noted in previous editions of Who Benefits from GM Crops?, research continues to focus on new pesticide-promoting varieties that tolerate application of one or more herbicides.

In the US, the average yields of soybeans, cotton and corn increased three-, four- and more than six-fold, respectively, from 1930 to the beginning of the biotech era in the mid-late 1990s (see Figure 3) (Fernandez Cornejo, 2004). Significantly, overall cotton and soybean yields went flat in the six to ten years following the introduction of GM versions of these crops, the period during which GM adoption grew to over 75% for each crop. Improved soybean and cotton yields in 2004 and 2005 are attributable chiefly to favourable weather conditions. Only corn shows a persistent trend of yield increase into the biotech era, but even here the rate of increase is no greater than before biotech varieties were introduced. These observations suggest that genetic engineering has been, at best, neutral with respect to yield. Even the USDA admits that genetic engineering has not increased the yield potential of any commercialised GM crop (Fernandez Cornejo, 2006).

one feeding the world's poor? who benefits in times of "food crisis"?

continued

FIGURE 2 **YIELD INCREASE OF CORN, COTTON AND SOYBEANS IN THE US: 1930 - 2006**



Source: *Average yields of each crop expressed as multiples of the 1930 yield (i.e. "2" = twice the 1930 yield, "3" = triple the 1930 yield, etc.). Coloured lines represent average annual yields. Dotted/dashed lines represent five-year moving averages calculated by averaging the yield multiples for the year in question and the four preceding years. Based on data from US Dept. of Agriculture's National Agricultural Statistics Service: http://www.nass.usda.gov/QuickStats/indexbysubject.jsp?Pass_name=&Pass_group=Crops+%26+Plants&Pass_subgroup=Field+Crops.*

1.3a soybeans

There is, however, abundant evidence that GM soybeans have significantly lower yields than conventional varieties. All GM soybeans are Monsanto's Roundup Ready, glyphosate-tolerant varieties, which were planted on 59.7 million hectares worldwide in 2008 (Monsanto, 2008a) (larger than the area of France), making it by far the most widely planted GM crop. An analysis of over 8,200 university-based soybean varietal trials conducted in the US in 1998 revealed that Roundup Ready soybeans yielded on average 5.3% less than conventional varieties (Benbrook, 1999). Further trials carried out in 1999 and 2000 confirmed these results. According to agricultural scientist Dr. Charles Benbrook:

"There is voluminous and clear evidence that RR [Roundup Ready] soybean cultivars produce 5 percent to 10 percent fewer bushels per acre in contrast to otherwise identical varieties grown under comparable field conditions." (Benbrook, 2001)

Controlled studies point to several factors as being responsible for this lower yield. In 2001, University of Nebraska agronomists attributed a six per cent yield drag directly to unintended effects of the genetic modification process used to create the Roundup Ready soybean (Elmore et al, 2001). Yield-lowering effects of this sort are a serious, though little-acknowledged, technical obstacle of genetic engineering, and are one of several factors foiling efforts to develop viable GM crops with drought-tolerance, disease-resistance and other traits (Braidotti, 2008).

A 2007 study by Kansas State University shows that RR soybeans continue to suffer from reduced yield:

"GR [glyphosate-resistant] soybean yield may still lag behind that of conventional soybeans, as many farmers have noticed that yields are not as high as expected, even under optimal conditions." (Gordon, 2007)

In this study, glyphosate-treated GM soybeans yielded nine per cent less than a close conventional relative because the glyphosate treatment reduced the GM soybeans' uptake of manganese and potentially other nutrients essential to plant health and performance. Other studies have found that glyphosate kills beneficial soil microorganisms that help plants absorb nutrients from the soil and promotes growth of disease-causing fungi. So the same factors implicated in the GM soybean yield drag may also be responsible for increased susceptibility to disease (Freese, 2007).

GM soybeans' lower yield has a substantial economic impact on farmers. A six per cent yield drag corresponds to a substantial loss in production of 160 lbs per acre. By one estimate, this drag on soybean yields cost US soybean farmers $1.28 billion in lost revenues from 1995 to 2003 (Sullivan, 2004).

The biotech industry's claim of greater productivity from GM crops has also been shown as false in Brazil, corroborating evidence collected in the US. Yields only surpassed the average in 2007 – for the first time since GM soy's approval in 2004 – because of exceptional weather (CONAB, September 2007). The record harvests of 2006/07 and 2007/08 have, according to CONAB, only been achieved by favourable weather conditions and the "expansion of the area of planting, stimulated by the remunerative prices of the market". Previously farmers had been beset by low soy prices, bad weather and a strong local currency (Real). While ISAAA maintain that herbicide tolerance does not negatively affect productivity (ISAAA, January 2006b), research suggests that Roundup Ready soy suffers a 5-10% 'yield drag' and has fared comparatively worse than conventional soy crops since its initial introduction, especially when faced with drought (FoEI, 2008). Weather conditions and prices seem to be the main factors affecting farmers' livelihoods and driving farmer decisions, not the GM technology.

Why do farmers grow GM herbicide-tolerant soybeans if they don't deliver increased yield and/or income? For some, reduced yields are accepted as the price to be paid for simplification and labour-saving in weed management, which are especially attractive to large growers. Others would prefer to grow non-GM crops, but find it increasingly difficult to find high-quality conventional seeds (FoEI, 2006, 2008).

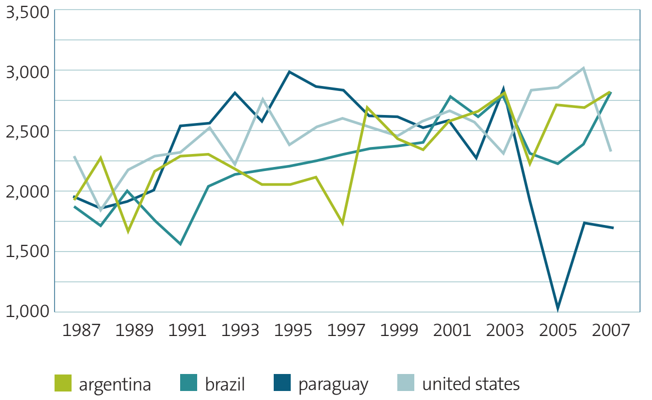
As noted above, Monsanto is poised to introduce a new version of Roundup Ready soybeans – called Roundup Ready 2 Yield (RR2Y) – that the company claims yields 7-11% more than original RR soybeans. If true, at best this would compensate for the yield drag discussed above and bring RR2Y yields up to those of high-quality conventional soybeans (BRP, 2008). However, there are several reasons to doubt Monsanto's increased yield claim. First, Monsanto officials have consistently denied the fact that original RR soybeans have suffered and continue to suffer from reduced yield (Freese, 2008). This history of deceit does not make the company a credible source for claims about its new soybeans. Secondly, we are aware of no field trials conducted by university agronomists that corroborate Monsanto's yield claims. Monsanto has a history of denying its GM crops to independent researchers for testing purposes, and in one case even rejected a request from a USDA plant geneticist (May et al, 2003). This also does not inspire confidence.

Finally, the substantially increased price of RR2Y soybeans is likely to turn out to have an indirect yield-lowering effect. As mentioned above, Ohio State University has reported that RR2Y seeds are priced at $78 per planted acre, nearly a 50% increase over the $53 per acre price of original Roundup Ready soybeans, and well over double the $34 per acre cost of non-GM seed (OSU, 2008). In the pre-GMO era of inexpensive seeds, farmers could seed their fields as densely as needed to obtain optimum yields. While the soybean seeding rate needed for optimal yield varies by region, soil quality, cultivation practices and other factors, trials conducted in 2004 in North Dakota are fairly representative and demonstrate that planting 200,000 seeds per acre delivers on average 16% higher yield than 100,000 seeds per acre (NDSU, 2004). For several years now, however, some agronomists have advised farmers to accept the lower yields that come with planting fewer seeds, because the value of increased yield from planting more seeds is exceeded by the incremental cost of those expensive GM seeds. The Iowa State University extension service presents a concrete example:

"Compared to a final stand of 105,000 and 106,000 ppa [plants per acre], yield was increased significantly with a final stand of 146,000 ppa in Study 1 and a 174,000 ppa in Study 2 (Figure 2). However, when seed costs are included, the increased seeding costs offset the value of the increased yield." (ISU, 2007)

This ISU publication refers to the seed costs of original Roundup Ready soybeans. With seed costs increasing by nearly 50% with RR2Y, farmers are likely to accept still greater yield reductions from lower seeding rates to optimise net returns when they plant RR2Y. In short, the dramatically rising price of GM seeds has the real potential to lower yields.

FIGURE 3 **SOYBEAN YIELDS IN THE TOP FOUR SOYBEAN PRODUCERS 1987-2007 (KG/HA)**

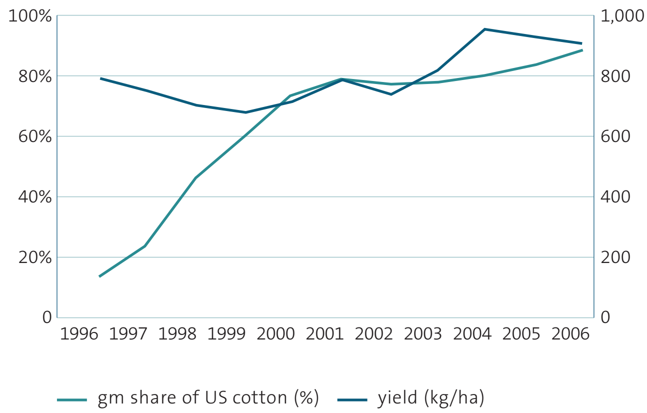


Source: *Friends of the Earth International, 2008 - Based on data from FAOSTAT, ProdStat, Crops, Subject: Yield per hectare (kg/ha), Commodity: soybeans; Country: United States, Argentina, Brazil, Paraguay; Year 1987-2007, (last accessed 6 October 2008)*

1.3b cotton

As noted above, US cotton yields stagnated during the period of GM cotton adoption (Figure 5). An exhaustive four-year comparison of GM vs. conventional cotton varieties in Georgia found that economic returns from conventional cotton were always higher than, or equal to, returns from GM varieties. Tellingly, the authors of this 2008 study concluded that: "profitability was most closely associated with yields and not the transgenic technologies" (Jost et al. 2008).

FIGURE 4 **AVERAGE COTTON YIELD VERSUS GM SHARE OF US COTTON: 1996 - 2002**



one feeding the world's poor? who benefits in times of "food crisis"?

continued

Rigorous studies comparing the yields of Bt and non-Bt crops under controlled conditions are rare. One such study demonstrated that Bt corn yields anywhere from 12% less to the same as near-isoline (genetically similar) conventional varieties (Ma & Subedi, 2005). While Bt crops can reduce yield losses when infestation with those insects targeted by the Bt insecticide is heavy, such conditions are infrequent with corn, while cotton is afflicted with many secondary pests not affected by the Bt insecticide (see inset).

To sum up, no commercial GM crop has been modified for enhanced yield. GM herbicide-tolerant soybeans and cotton simplify and reduce labour needs for weed control, but deliver lower yields and/or less income than conventional varieties; and insect-resistant cotton has frequently failed poor farmers in Asia. Yield is most heavily influenced by crop genetics as developed through conventional breeding, as well as weather conditions, use of irrigation, and other non-biotech factors.

box 4 insect-resistant gm cotton fails in asia

Bt cotton has repeatedly failed farmers in Asia. One reason is that cotton is afflicted with roughly 150 insect pests (Khashkehli), the vast majority of which are not killed by the built-in Bt insecticide. Outbreaks of these "secondary pests" – which include mealy bugs, mirids, aphids, thrips and jassids – have drastically lowered yields and led many Bt cotton farmers in India (Ghosh, 2007), Pakistan (Syed, 2007) and China (Connor, 2006) to purchase and apply as much chemical insecticide as growers of conventional cotton. But because they have paid up to four times as much for the biotech seed, they end up falling into debt. In 2007, over 900 Indian cotton farmers in the Vidarbha cotton belt committed suicide from despair over insurmountable debts (FoEI, 2008). In addition, Bt cotton planted in India was developed by Monsanto for the shorter US growing season, and often fails to defend against even targeted insect pests late in India's longer growing season (Jayaraman, 2005).

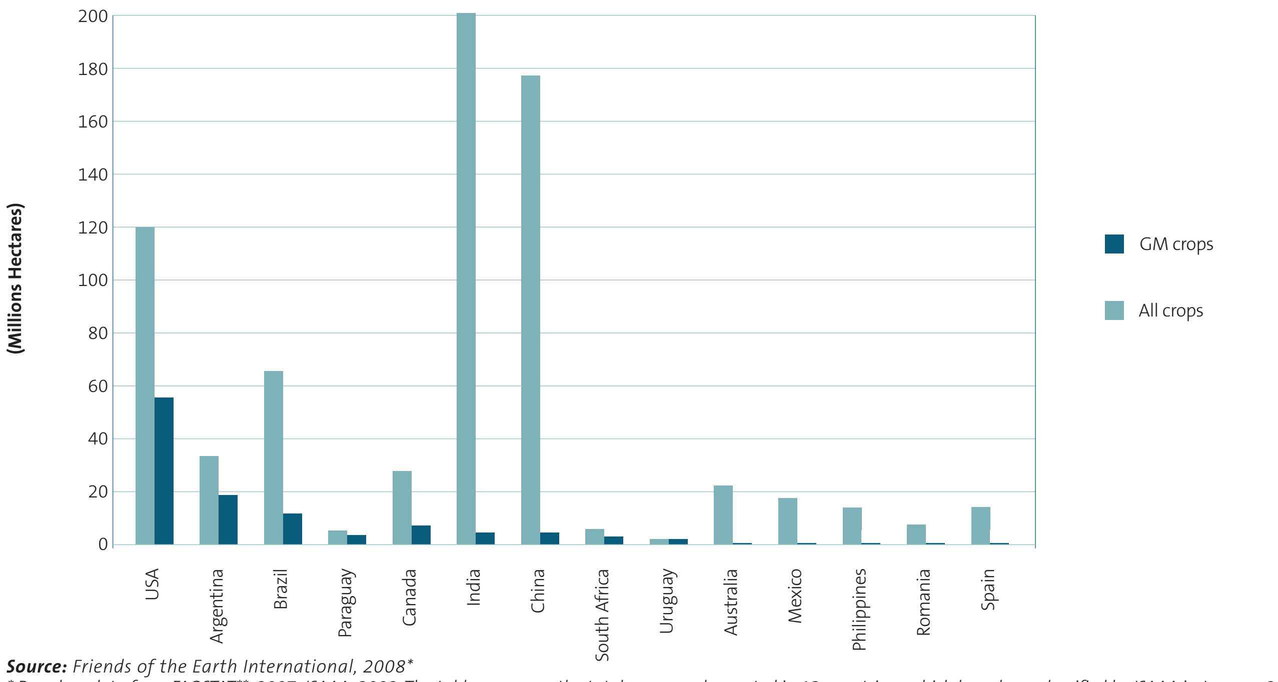
Two immature Cotton Stainers crawl over an opening boll of cotton.

two the status of gm crops in the world: four crops, two traits and a handful of countries

Although more than a decade has passed since genetically modified (GM) crops first entered the world's food and feed supply, they continue to be the province of a handful of nations with highly-industrialised, export-oriented agricultural sectors.

Over 90% of the area planted to GM crops is found in just five countries located in North & South America: the US, Canada, Argentina, Brazil and Paraguay. One country alone, the United States, produces more than 50% of the world's GM crops; the US and Argentina together grow more than 70% of all GM crops. The European Union, one of the key markets for the biotech industry, remains closed to GM crops with public opinion consistently opposed to GM foods for more than 10 years now (see chapter five).

FIGURE 5 **TOP GM CROP PRODUCERS. MEGA-BIOTECH COUNTRIES?**
TOTAL CROP AREA HARVESTED PER COUNTRY VS. AREA PLANTED WITH GENETICALLY MODIFIED CROPS, 2006.



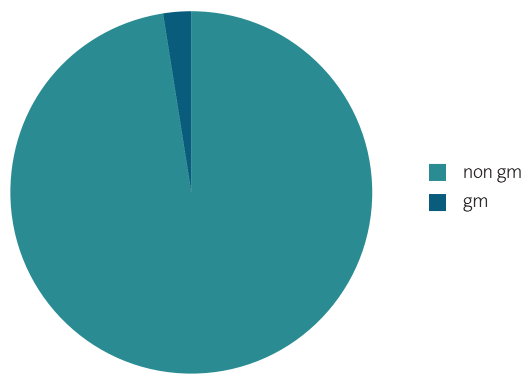
Source: *Friends of the Earth International, 2008**
** Based on data from FAOSTAT**, 2007; ISAAA. 2008. The table compares the total crop area harvested in 13 countries, -which have been classified by ISAAA in January 2008 as "Mega-biotech" countries- to the total hectares, which are estimated, to be planted to GM crops in each of the 13 countries. The 13 so called "Mega-biotech" countries are US Argentina, Brazil, Paraguay, Canada, India, China, South Africa (SA), Uruguay, Australia, Mexico, Philippines and Spain. ** Note: Data from FAOSTAT is based on ProdSTAT, Crops, Subject: Area Harvested: Countries: USA, Argentina, Brazil, Paraguay, Canada, India, China, South Africa, Uruguay, Australia, Mexico, Philippines, Romania, Spain. Commodities: data on all crops includes the total harvested area in million ha of the following main crops groups: cereals, fruits, fibres vegetal origin, oilcrops, nuts, spices, stimulants, pulses, roots and tubers, selected fodder crops, sugarcrops, tobacco and vegetables. Year: 2006 last accessed (13 December 2007). http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567*

TABLE 2 **SOY EXPORT MARKETS, % EXPORTS**

	PRODUCTION	INDUSTRY	%
EU	79.4	46.6	58.7
Brazil	59.0	31.5	53.4
Argentina	50.5	35.9	71.1
China	16.8	41.4	246.4
India	9.7	8.3	85.6
EU 27	1.2	13.6	1,133.3

Source: *based on USDA data. 2008.*

FIGURE 6 **% GLOBAL AGRICULTURAL LAND**



two the status of gm crops in the world: four crops, two traits and a handful of countries continued

FIGURE 7 % AGRICULTURAL LAND IN 23 COUNTRIES THAT GROW GM CROPS

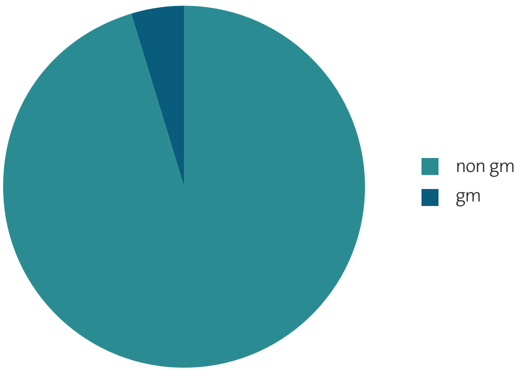


TABLE 3 GM CROPS AS A PERCENTAGE OF AGRICULTURAL LAND

	TOTAL AGRICULTURAL LAND HA[35]	TOTAL GM CROPS HA[36]	GM AS PERCENTAGE OF TOTAL
Global	4,803,385,400	114,300,000	2.4%
23 global GM countries' agricultural land	2,494,141,000	114,300,000	4.5%

Source: *GM Freeze, June 2008*[37]

TABLE 4 GM CROPS AS A PERCENTAGE OF ARABLE LAND

	TOTAL ARABLE LAND HA[38]	TOTAL GM CROPS HA[39]	GM AS PERCENTAGE OF TOTAL
Global	1,365,069,800	114,300,000	8.4%
23 global GM countries' arable land	745,685,000	114,300,000	15.3%

Note: *Table 4 shows the percentage of arable*[40] *land under GM crops.*
Source: *GM Freeze, June 2008*[41]

After more than a decade of commercialisation, GM crops continue to occupy just a small share of the total crop area harvested in the world. The ISAAA ranks some 13 countries as "biotech mega-countries" (See Table 3), each of which plants at least 50,000 ha. Although the designation "mega" implies these countries sow vast tracts of land with GM crops, in fact the 50,000 ha threshold is so low that GM plantings make up a mere 2.4% of global agricultural crop land (see table 3 and figure 6 above). Only four countries plant GM crops on more than 30% of their arable land: the US, Argentina, Paraguay and Uruguay. The area of arable land in Paraguay and Uruguay is so small that even these high percentages amount to comparatively little GM crop (See Table 5).

FIGURE 8 % GLOBAL ARABLE LAND

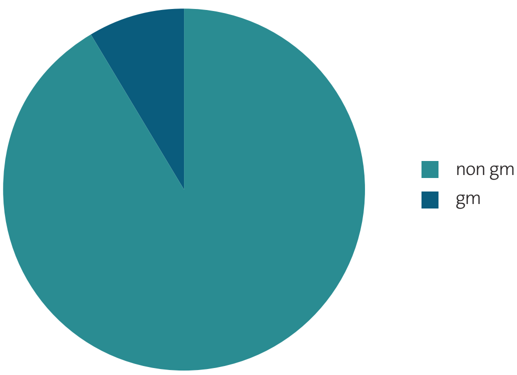


FIGURE 9 % ARABLE LAND TAKEN UP BY GM AND NON GM CROPS IN THE 23 COUNTRIES WHERE GM CROPS ARE GROWN

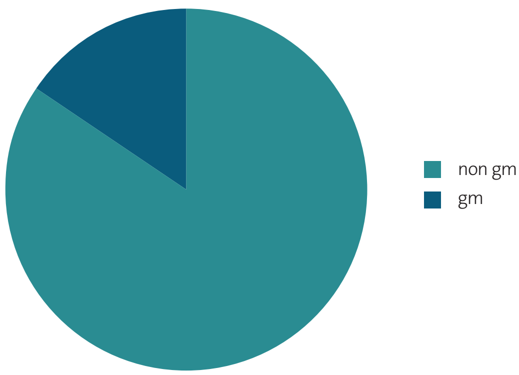


TABLE 5	THE "MEGABIOTECH COUNTRIES"*: TOTAL AREA OF CROPS HARVESTED VERSUS GM CROPS PLANTED IN 2007 BY COUNTRY (MILLION HECTARES)			
RANK*	**COUNTRY**	**AREA PLANTED WITH GM CROPS**	**TOTAL AREA HARVESTED WITH ALL CROPS****	**GM CROPS**
1	USA	57.7	118.6	Soybean, maize, cotton, canola***
2	Argentina	19.1	32.3	Soybean, maize, cotton
3	Brazil	15	64.2	Soybean, cotton
4	Canada	7	27.09	Canola, maize, soybean
5	India	6.2	199.7	Cotton
6	China	3.8	176.1	Cotton
7	Paraguay	2.6	4.5	Soybean
8	South Africa	1.8	5.05	Maize, soybean, cotton
9	Uruguay	0.5	0.95	Soybean, maize
10	Philippines	0.3	12.9	Maize
11	Australia	0.1	21.1	Cotton
12	Mexico	0.1	16.8	Cotton, soybean
13	Spain	0.1	12.5	Maize

Source: *FAOSTAT;2007**; ISAAA, 2008.*
*** 13 so-called "biotech mega-countries" growing 50,000 hectares or more of biotech crops*
***** Data from FAOSTAT is based on ProdSTAT, Crops, Subject: Area Harvested: Countries: USA, Argentina, Brazil, Paraguay, Canada, India, China, South Africa, Uruguay, Australia, Mexico, Philippines, and Spain. Commodities: data on all crops includes the total harvested area in million ha of the following main crops groups: cereals, fruits, fibres vegetal origin, oilcrops, nuts, spices, stimulants, pulses, roots and tubers, selected fodder crops, sugarcrops, tobacco and vegetables. Year: 2006 last accessed (13 December 2007).*
******* *Some extremely low but unknown area is also planted to GM squash and papaya*

Left: Bt cotton, India.
Right: Young crops of maize and silver leaf, ICIPE field station Mbita Point, Suba District, Kenya.

There has also been a decade-long stagnation in the diversity of GM crops. As in the mid to late 1990s, only four crops – soya, maize, cotton and canola – comprise virtually 100% of biotech agriculture, as even ISAAA is forced to concede. Biotech versions of rice, wheat, tomatoes, sweetcorn, potatoes and popcorn have been rejected as unacceptable in the world marketplace (Center for Food Safety, August 2006). The initial approval of GM alfalfa in the US was reversed in 2006 by a federal judge, who castigated the US Dept of Agriculture (USDA) for failing to conduct a serious assessment of its environmental impacts (FoEI, 2008).

Perhaps most surprising is the stagnation of GM traits. Despite more than a decade of hype and failed promises, the biotechnology industry has not introduced a single GM crop with increased yield, enhanced nutrition, drought-tolerance or salt-tolerance. Disease-tolerant GM crops are practically non-existent. In fact, biotech companies have made a commercial success of GM crops with just two traits – herbicide tolerance and insect resistance – which offer no advantages to consumers or the environment. In fact, GM crops in the world today are best characterised by the overwhelming penetration of just one trait – herbicide tolerance – which is found in over 80% of all GM crops planted worldwide (See Table 6 below), and which as we explore further below is associated with increased use of chemical pesticides.

TABLE 6	GM CROPS IN THE WORLD	
GM CROP	**AREA PLANTED (MILLION HA)**	**%**
Soybean	58.6	51
Maize	35.2	31
Cotton	15	13
Canola	5.5	5
Total	**114.3**	**100**

TABLE 7	GM TRAITS IN THE WORLD	
GENETICALLY MODIFIED TRAITS	**AREA PLANTED (MILLION HA)**	**%**
Herbicide Tolerance	72.2	63
Bt crops	20.3	18
HT + BT (Stacked traits)	21.8	19
Total	**114.3**	**100**

Source: *ISAAA, 2008*

three the rise in pesticide use

the rise in pesticide use

More than a decade of experience in the United States demonstrates that GM crops have contributed substantially to increased pesticide use and an epidemic of herbicide-resistant weeds. Resistant weeds have prompted biotechnology firms to develop new GM crops that promote pesticide use still more. The use of mechanical tillage to control resistant weeds is also increasing, contributing to greater soil erosion and greenhouse gas emissions.

3.1 biotech industry continues to develop pesticide-promoting, herbicide-tolerant gm crops

Pesticides are chemicals that target weeds (herbicides), insects (insecticides) or other pests. Pesticide-promoting, herbicide-tolerant crops continue to dominate agricultural biotechnology. Four out of every five hectares of biotech crops worldwide were engineered for heavy applications of chemical herbicides (See Table 7). Agricultural biotechnology is essentially pesticide-promoting technology.

The biotechnology industry has continued to focus its development efforts on new pesticide-promoting crop varieties. Of the four new biotech crops approved by the USDA from November 2006 to December 2007, two were herbicide-tolerant (soybeans and rice). One insect-resistant corn and one virus-resistant plum variety were also approved (APHIS, 5 October 2007).[42]

The most significant developments in biotech agriculture are new GM crops that tolerate heavier applications of chemicals, and that tolerate two herbicides rather than just one. As discussed further below, this is the biotechnology industry's short-sighted "solution" to the epidemic of herbicide-resistant weeds that are plaguing American (and world) agriculture. None of the GM crops on the market are modified for increased yield potential. Corporations' research and product pipelines continue to focus on new pesticide-promoting varieties that tolerate the application of one or more herbicides. For instance, of the 14 GM crops awaiting USDA commercial approval, nearly half (6) are herbicide-tolerant: corn, soybeans, cotton (2), alfalfa and creeping bentgrass (for golf courses). None of the others represent beneficial new traits. Corn and cotton with insect-resistance are minor variations on existing IR crops. Virus-resistant papaya and soybeans with altered oil content are already approved, though not grown to any significant extent. Carnations engineered for altered colour are a trivial application of biotechnology. One GM corn is engineered for sterile pollen, while another engineered to contain a novel enzyme for "self-processing" into ethanol presents potential risks to human health.

TABLE 8 **THE 14 GM CROPS PENDING DEREGULATION (COMMERCIAL APPROVAL) BY USDA***

TRAIT	NO.	NOTES
Tolerate 1 herbicide	5	Glyphosate-tolerant alfalfa and creeping bentgrass (golf course grass) (Monsanto) Glyphosate-tolerant (1) and glufosinate-tolerant/insect-resistant (1) cotton (Bayer) ALS inhibitor-tolerant soybeans (BASF)
Tolerate 2 herbicides	1	Dual herbicide-tolerant corn tolerates glyphosate and imidazolinones (a class of ALS inhibitor herbicides)[43] (DuPont-Pioneer)
Insect-resistant alone	2	Corn and cotton (Syngenta)
Virus-resistant	1	New version of old papaya trait (University of Florida)
Enzyme added	1	Corn w/ alpha-amylase enzyme derived from deep sea microorganisms for processing into ethanol. First GE industrial crop. Novel enzyme in corn has characteristics of food allergens, leading top U.S. food allergists to call for more careful evaluation of potential allergy-causing potential of this corn variety. South Africa has refused import clearance based in part on inadequate analysis of potential health impacts from consumption of this corn (Syngenta).
Sterile pollen, fertility altered	2	Corn with sterile pollen (DuPont-Pioneer); freeze-tolerant eucalyptus tree with altered fertility (ArborGen)
Oil alteration	1	High oleic acid soy for processing (DuPont-Pioneer)
Color alteration	1	Carnation (Florigene)

** as of February 5, 2009.*
***Source:** USDA Petitions for Nonregulated Status Pending, February 5, 2009, at: http://www.aphis.usda.gov/brs/not_reg.html (last accessed February 9, 2009).*

The longer-term future of biotech agriculture is also dominated by pesticide-promoting crops. Field trial permit figures are the best predictor of trends in GM crop development. Over one-third (36.3%) of active field trial permits for GM crops in the US involve one or more herbicide tolerant (HT) traits.[44] These 352 active permits for field trials of HT crops encompass 18 different plant species and tolerance to more than eight different herbicides. Glyphosate-tolerance is by far the most common HT trait in field tests, though others, especially crops tolerant to dicamba herbicide, are also being extensively tested.

3.2 gm crops have increased pesticide use in the us

The biotechnology industry asserts that reduced pesticide use (i.e. herbicides, insecticides) is one of the most valuable benefits of its technology, particularly in connection with GM soy (Monsanto, 2005b). Yet independent studies have demonstrated not only that these pesticide reduction claims are unfounded, but that GM crops have substantially increased pesticide use, particularly since 1999. Dr. Benbrook conducted an exhaustive analysis of USDA data on pesticide use in agriculture from 1996 to 2004. His conclusion was that over this nine-year period, the adoption of GM soy, corn, and cotton has led to the use of 122 million more lbs of pesticides than would have been applied if these GM crops had not been introduced. A small decrease in insecticide use attributable to insect-resistant corn and cotton (-16 million lbs) has been swamped by a much larger increase in herbicide use on herbicide-tolerant crops (+138 million lbs) (Benbrook, C. 2004).

Much of this increasing herbicide use is attributable to a dramatic rise in application of glyphosate (Roundup) on Monsanto's glyphosate-tolerant (Roundup Ready) crops. In 1994, the year before the first Roundup Ready crop (RR soy) was introduced, 7,933 million lbs of Roundup were used on soybeans, corn and cotton. By 2005, glyphosate use on these three crops had increased 15-fold, to 119,071 million lbs (Table 9). Over the same period, Roundup Ready crop acreage[45] in the U.S. increased from 0 acres (1994) to 102 million acres (2005), an area larger than the state of California. In 2006, Roundup Ready crop acreage rose 14% more, to 116 million acres.

Initially, the rising use of glyphosate on Roundup Ready crops was more than offset by reductions in the use of other pesticides. Beginning in 1999, however, weeds that could no longer be controlled with the normal dose of glyphosate began to emerge, driving farmers to apply more of it (see Section 3.4). Thus, the widespread adoption of Roundup Ready crops combined with the emergence of glyphosate-resistant weeds has driven a more than 15-fold increase in the use of glyphosate on major field crops from 1994 to 2005. The trend continues. In 2006, the last year for which data are available, glyphosate use on soybeans jumped a substantial 28%, from 75,743 million lbs in 2005 to 96,725,000 million lbs in 2006 (See Table 9).[46]

TABLE 9 **ADOPTION OF HERBICIDE-TOLERANT GM CROPS VS. QUANTITY OF GLYPHOSATE APPLIED IN THE US**

YEAR	SOYBEANS GLYPHOSATE APPLIED[A]	% = HT[B]	CORN GLYPHOSATE APPLIED[A]	% = HT[B]	COTTON GLYPHOSATE APPLIED[A]	% = HT	SOYBEANS, CORN, COTTON GLYPHOSATE APPLIED	NOTES
1994	4,896,000	0%	2,248,000	0%	789,189	0%	7,933,189	The first HT crop, Roundup Ready soybeans, were introduced in 1995.
2002	67,413,000	75%	5,088,000	11%	n.a.	74%[C]	n.a.	
2003	n.a.	81%	13,696,000	15%	14,817,000		n.a.	
2005	75,743,000	87%	26,304,000	26%	17,024,000		119,071,000	More than 15-fold increase in glyphosate use on soybeans, corn and cotton from 1994 to 2005.
2006	96,725,000	89%	n.a.	36%	n.a.	86%[D]	n.a.	More than 19-fold increase in glyphosate use on soybeans, the most widely planted Roundup Ready crop, from 1994 to 2006.
2007	n.a.	91%	n.a.	52%	18,572,000	92%[E]	n.a.	

[A]: Pounds of active ingredient. Source for all crops: "Agricultural Chemical Usage: Field Crops Summary," USDA National Agricultural Statistics Service, for the respective years. Accessible from: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1560. The figures represent sum of all versions of glyphosate, including sulfosate. USDA pesticide usage figures cover only a certain percentage of the nationwide acreage planted to the given crop, a percentage which varies from year to year. In order to obtain the best estimate of nationwide use, we have corrected by dividing total reported glyphosate use by the percentage of the nationwide crop acreage for which pesticide usage data was reported. n.a. = not available, note that USDA does not report pesticide usage for all crops in all years. [B]: Percentage of overall crop acreage planted to herbicide-tolerant varieties. From USDA's Economic Research Service (ERS), see: http://www.ers.usda.gov/Data/BiotechCrops/alltables.xls. Figures are the sum of percentages listed for "herbicide-tolerant only" and "stacked gene varieties." As defined by ERS, stacked gene varieties always contain an HT trait. All HT soybeans are Roundup Ready. In 2006, 96% of HT cotton was Roundup Ready, 4% was tolerant to glufosinate (LibertyLink). Most HT corn is Roundup Ready; a small but unknown percentage is tolerant to glufosinate (LibertyLink). [C]: May, O.L., F.M. Bourland and R.L. Nichols (2003). "Challenges in Testing Transgenic and Nontransgenic Cotton Cultivars," Crop Science 43: 1594-1601. http://crop.scijournals.org/cgi/reprint/43/5/1594.pdf. Figure calculated by adding all HT varieties in Table 1. Based on USDA AMS data, see next footnote. [D]: From USDA's Agricultural Marketing Service (AMS), which has more reliable statistics on cotton than USDA's ERS. See: "Cotton Varieties Planted: 2006 Crop," USDA AMS. Figure calculated by adding percentages of all HT varieties (those with designations R, RR = Roundup Ready or RF = Roundup Ready Flex and LL for LibertyLink). Note that most HT cotton is Roundup Ready (Flex); LL cotton varieties comprised only 3-4% of US cotton in 2006. [E]: From "Cotton Varieties Planted: 2007 Crop," USDA AMS, at: http://www.ams.usda.gov/mnreports/cnavar.pdf.

three the rise in pesticide use

continued

3.3 herbicide-resistant weeds and pesticide use

Just as bacteria develop resistance to over-used antibiotics, so weeds develop resistance to chemicals designed to kill them. Weed resistance to chemical herbicides first emerged in the United States in the 1970s, and has been growing ever since. From the 1970s to the present day, weeds with documented resistance to one or more herbicides have been reported in up to 200,000 sites covering 15 million acres.[47] The problem is likely to be far worse in reality, since these figures include only documented resistance and exclude numerous field reports of suspected weed resistance. The first major wave that began in the late 1970s involves 23 species of weeds resistant to atrazine and related herbicides of the photosystem II inhibitor class, which have been reported to infest up to 1.9 million acres of cropland in the US. The second major wave began in the 1980s, and involves 37 species of weeds resistant to ALS inhibitors, which have been reported in up to 9.9 million acres (FoEI, 2008). The third major wave involves glyphosate-resistant weeds, to which we turn in the next section.

It is important to understand two key facts about weed resistance. First, resistance is defined as a weed's ability to survive more than the normal dose of a given herbicide rather than absolute immunity. Higher doses of the herbicide will often still kill the resistant weed, at least in the short-term. The second fact follows from the first. Weed resistance is not only the result of using a herbicide excessively, it often leads to still greater use of that herbicide.

3.4 glyphosate-resistant weeds

Monsanto first introduced glyphosate in the US in 1976 (Monsanto, 2007b), and for two decades there were no reports of glyphosate-resistant weeds. By 1998, only rigid ryegrass had developed resistance to the chemical in California. Extensive weed resistance first developed only several years after the introduction of Monsanto's Roundup Ready soybeans in 1995, Roundup Ready cotton and canola in 1997, and Roundup Ready corn in 1998 (Monsanto, 2007b). Scientists who first identified glyphosate-resistant horseweed in Delaware in 2000 attributed their evolution to the continuous planting of Roundup Ready crops (University of Delaware, 22 February 2001). Ten prominent weed scientists confirmed this assessment in 2004:

"It is well known that glyphosate-resistant horseweed (also known as marestail) populations have been selected in Roundup Ready soybean and cotton cropping systems. Resistance was first reported in Delaware in 2000, a mere 5 years after the introduction of Roundup Ready soybean. Since that initial report, glyphosate-resistant horseweed is now reported in 12 states and is estimated to affect 1.5 million acres in Tennessee alone." (Hartzler et al, February 20 2004)

TABLE 10	DEVELOPMENT OF WEEDS RESISTANT TO GLYPHOSATE IN THE UNITED STATES: 1998-2008
Amaranthus palmeri Palmer Amaranth	2005 - USA (Georgia) 2006 - USA (Arkansas) 2006 - USA (Tennessee) 2008 - USA (Mississippi)
Amaranthus rudis Common Waterhemp	2005 - USA (Missouri), includes weeds resistant to glyphosate and one or 2 other herbicides 2006 - USA (Illinois) includes weeds resistant to glyphosate and one other herbicide 2006 - USA (Kansas) 2006 - USA (Kansas) 2007 - USA(Minnesota)
Ambrosia trifida Giant Ragweed	2004 - USA (Ohio) 2005 - USA (Indiana) 2006 - USA (Kansas) 2006 - USA(Minnesota) 2007 - USA (Tennessee)
Ambrosia artemisiifolia Common Ragweed	2004 - USA (Arkansas) 2004 - USA (Missouri) 2007 - USA (Kansas)
Conyza bonariensis Hairy Fleabane	2007 - USA (California)
Conyza canadensis Horseweed	2001 - USA (Tennessee) 2002 - USA (Indiana) 2002 - USA (Maryland) 2002 - USA (Missouri) 2002 - USA (New Jersey) 2002 - USA (Ohio) 2003 - USA (Arkansas) 2003 - USA (Mississippi) 2003 - USA (North Carolina) 2003 - USA (Ohio) 2003 - USA (Pennsylvania) 2005 - USA (California) 2005 - USA (Illinois) 2005 - USA (Kansas) 2007 - USA (Michigan)
Lolium multiflorum Italian Ryegrass	2004 - USA (Oregon) 2005 - USA (Missisipi)
Lolium rigidum Rigid Ryegrass	1998 - USA (California)
Sorghum halepense Johnsongrass	2007 - USA (Arkansas)

Source: *Weedscience, 2008. Glycines resistant weeds by species and country. http://www.weedscience.org/Summary/UspeciesMOA.asp?lstMOAID=12&FmHRACGroup=Go*

Weeds with documented resistance to glyphosate now infest an estimated 3,251 sites covering 2.37 million acres in 19 states (Weed Science, 2007). Multiple populations of nine different weed species have developed resistance in the US: Palmer amaranth, common waterhemp, common ragweed, giant ragweed, horseweed, Italian ryegrass, rigid ryegrass, hairy fleabane and Johnsongrass (Weed Science, 2008). Five additional weed species have developed glyphosate-resistance overseas. Out of the 58 cases of new glyphosate-resistant weeds identified in the last decade around the world, 31 were identified in the US (Table 5). Thirty of those appeared in the US between 2001 and 2007.

Since glyphosate-resistant weeds can usually still be killed by higher than normal doses of the herbicide, farmers began to apply more glyphosate to kill resistant weeds. USDA data confirm these trends. From 1994 to 2006, glyphosate use per acre of soybeans increased by more than 2.5-fold, from just 0.52 to 1.33 lbs/acre/year. Glyphosate use on corn rose only slightly from 1994 (0.67 lbs/acre/year) to 2002 (0.71 lbs/acre/year). Yet during the period of rapid Roundup Ready corn adoption from 2002 to 2005, usage jumped from 0.71 to 0.96 lbs/acre/year, a hefty 35% increase in just three years (NASS, 2007). These are clear signs of escalating weed resistance to glyphosate.

Agricultural scientists are sounding the alarm. North Carolina weed scientist Alan York has called glyphosate-resistant weeds "potentially the worst threat [to cotton] since the boll weevil," the devastating pest that virtually ended cotton-growing in the US until an intensive spraying programme eradicated it in some states in the late 1970s and early 1980s (Minor, December 18, 2006). York concedes that: "Resistance is not unique with glyphosate," but goes on to state that: "What makes glyphosate resistance so important is our level of dependence on glyphosate" (Yancy, June 3, 2005). Weed scientists report that there are no new herbicides with different "modes of action" on the horizon. Thus, the loss of glyphosate as an effective means of weed control poses extremely serious problems for US agriculture (Roberson, R., October 19, 2006).

Several factors make it virtually certain that glyphosate-resistant weeds will become much worse in the future. These factors include: 1) more weed species developing resistance; 2) more planting of glyphosate-tolerant crops in rotation (every year); 3) new glyphosate-tolerant crops on the horizon; and 4) new crops that withstand higher doses of glyphosate.

Weed species with suspected resistance to glyphosate include velvetleaf (Owen, 1997), cocklebur and lambsquarters (Roberson, R., October 19, 2006), morning glories (UGA, August 23, 2004), and tropical spiderwort (USDA ARS, August 24, 2004). Annual grasses such as goosegrass, foxtails, crowfootgrass, signal grasses, panicums, and crabgrasses, all have a history of developing resistance to multiple herbicides (Robinson, E. February 16, 2005), making development of glyphosate-resistance more likely in these species. Glyphosate-resistant Johnsongrass is rapidly becoming a huge threat to Argentine agriculture (FoEI, 2008), and has already appeared in the US as well.

Secondly, the growing trend to plant Roundup Ready crops in rotation is ensuring the faster development of resistant weeds because of the application of glyphosate every year. This is particularly a concern with the popular soybean-corn rotation. While 89% of US soybeans were Roundup Ready in 2006, only one-third of corn was Roundup Ready. However, acreage planted to Roundup Ready corn has been increasing rapidly in recent years: from just 7.8 million acres in 2002 to 32.7 million acres in 2006 (Monsanto, October 11, 2006) - more than a four-fold increase in just four years. According to Iowa State University weed expert Michael Owen, this rapid adoption of Roundup Ready corn will lead to "an increasing number of crop acres where glyphosate will follow glyphosate" in the popular corn-soybean rotation (Owen, 2005), vastly increasing selection pressure for glyphosate-resistant weeds.

Thirdly, more glyphosate-resistant crops are on the horizon. Roundup Ready alfalfa and creeping bentgrass are awaiting approval by USDA (Table 8). USDA field trial figures show that biotechnology companies are experimenting with glyphosate-resistant versions of many other crops. In fact, 62% of ongoing field tests of herbicide-tolerant crops involve plants resistant to glyphosate (Information Systems for Biotechnology, 23 August 2007). The expanding use of glyphosate on millions of acres of new Roundup Ready crops is another factor that will speed up development of weed resistance.

Finally, biotechnology companies are developing crops with enhanced tolerance to glyphosate to enable farmers to apply still more of the chemical to kill resistant weeds. In 2006, Monsanto introduced Roundup Ready Flex cotton, a new version that tolerates higher rates of glyphosate than the original Roundup Ready cotton, and allows farmers to apply it over the entire growing season instead of only in the early life of the plant (Bennett, D. February 24, 2005). Other companies are also getting involved. DuPont-Pioneer is poised to introduce GAT soybeans, which are tolerant to both higher doses of glyphosate as well as to a second class of herbicides, ALS inhibitors. The company has proposed "enhancing" the glyphosate-tolerance of GAT soybeans still further by combining up to three different mechanisms of glyphosate tolerance in a single crop (Center for Food Safety, 4 December 2007). DuPont-Pioneer is also awaiting USDA approval of a dual-herbicide tolerant corn variety, which like GAT soybeans tolerates both glyphosate and imidazolinones, a class of ALS inhibitor herbicide (Table 8).

three the rise in pesticide use

continued

Ironically, the most prevalent herbicide-resistant weeds in the US survive the application of normal doses of precisely these two classes of herbicide: ALS inhibitors (#1) and glyphosate (#2). Weeds that tolerate multiple herbicides are a growing problem in American agriculture. So far, such "cross-resistant" weeds have been documented on roughly 1,500 sites covering a quarter of a million acres, including weeds resistant to glyphosate and one or two other herbicides.[48]

The vastly increased glyphosate use from introduction of these new crops is clearly not sustainable. Epidemic weed resistance to the chemical will soon render it ineffective. Monsanto is already preparing for the demise of Roundup Ready technology. In a recent issue of Science, the company reported that it is developing a new generation of crops resistant to the herbicide dicamba (Behrens et al, May 25, 2007). Dicamba belongs to the same class of phenoxy herbicides as 2,4-D, a component of the Vietnam War defoliant Agent Orange, and is known to have genotoxic and cytoxic effects (Gonzalez et al, 2007). In mixtures with other herbicides, it has also been associated with failed pregnancies in mice at very low doses (PAN, 2002).

Weed resistance to glyphosate in the US and in South America means that other pesticide and GM producing corporations are now competing to fill what the journal Chemical and Engineering News has termed the "glyphosate gap"(ETC group, 2008 [49]). According to Syngenta's Crop Science CEO, John Atkin: "Resistance is actually quite healthy for our market, because we have to innovate," (ETC group, 2008[50]). This is known as the "pesticide treadmill" whereby rather than addressing the agronomic and environmental problems posed by pesticide use and weed resistance, new pesticides (and new GM crops) are developed by companies seeking greater market control.

Soy bean pods.

3.5 gm crops increase use of other leading herbicides

When forced to admit that herbicide-tolerant crops increase overall pesticide use, biotech industry apologists quickly fall back on a second claim: the increasing use of glyphosate has reduced the use of more toxic herbicides, and so benefits the environment. While this was true in the first few years of Roundup Ready crops, a look at recent trends in herbicide use undermines this claim.

More and more, farmers are being told to combat glyphosate-resistant weeds by applying other chemicals, often in combination with higher rates of glyphosate. As early as 2002, Ohio State University agricultural advisers recommended using 2,4-D plus metribuzin plus paraquat as pre-emergence chemicals to control glyphosate-resistant marestail in Roundup Ready soy (Loux, and Stachler, 2002). In September 2005, reports of glyphosate-resistant Palmer amaranth in Georgia cotton fields prompted Monsanto to recommend that farmers use several additional herbicides with Roundup, including Prowl (pendimethalin), metolachlor, diuron and others. The company also suggested that farmers planting any RR crops use pre-emergence residual herbicides in addition to Roundup (Monsanto, September 13, 2005). In the same year, weed scientists in Tennessee noted that Palmer amaranth in the state survived applications of up to 44 ounces per acre of Roundup, and so recommended that farmers use additional herbicides such as Clarity, 2,4-D, Gramoxone Max or Ignite (Farm Progress, September 23, 2005).

In June 2006, reports of widespread populations of lambsquarters that could not be controlled even with application of up to 48 ounces per acre of Roundup prompted Iowa State University experts to recommend farmers use additional applications of Roundup and/or other chemicals, including Harmony GT, Ultra Blazer, and/or Phoenix herbicides (Owen, June 15, 2006). Also in 2006, it was reported that farmers were increasingly relying on older herbicides such as paraquat and 2,4-D to control glyphosate-resistant weeds (Roberson, 2006).

In 2007, Monsanto recommended that farmers use tillage and apply a pre-emergence herbicide in combination with Roundup to kill resistant weeds (Henderson & Wenzel, 2007). In the same year, the American Soybean Association sent out a similar message, advocating that farmers return to multiple-herbicide weed control systems on their Roundup Ready soybeans (Sellen, February 7, 2007).

Weed resistance to glyphosate was played out by USDA statistics, which confirmed an increase in the use of other leading herbicides (Table 11). For instance, 2,4-D is the second most-heavily used herbicide on soybeans (after glyphosate). 2,4-D is a phenoxy herbicide that formed part of the Vietnam War defoliant Agent Orange, and has been associated with a number of adverse health impacts on agricultural workers who apply it, including an increased risk of cancer, particularly non-Hodgkin's lymphoma, and an increased rate of birth defects in children of applicators. 2,4-D is also a suspected endocrine disruptor (Beyond Pesticides, July 2004). From 2002 to 2006, 2,4-D use on soybeans more than doubled from 1.39 to 3.67 million lbs, while glyphosate use on soybeans increased by 29 million lbs (43% rise). Clearly, glyphosate is not displacing 2,4-D, but rather both are being used at ever higher rates to kill resistant weeds.

Atrazine is the most heavily applied herbicide on corn, followed by acetochlor and S-metolachlor/metolachlor. Use of atrazine has been linked to endocrine disruption, neuropathy, breast and prostate cancer, and low sperm counts in men. Atrazine causes sex change and/or hermaphrodism in frogs and fish at extremely low levels. Based on this evidence, and the widespread presence of atrazine in drinking water supplies, the European Union announced a ban on atrazine in 2006 (Beyond Pesticides, 2003; LoE, 2006). At the same time that glyphosate use on corn climbed five-fold from 2002 to 2005, atrazine use rose by nearly 7 million lbs (12% increase), and aggregate applications of the top four corn herbicides rose by five percent (Table 10). Clearly, glyphosate is not displacing use of atrazine or other leading corn herbicides. All four are being used in larger quantities to kill glyphosate-resistant weeds.

The biotechnology-chemical companies that increasingly dominate world agriculture have "solutions" to resistant weeds: new crops that tolerate multiple herbicides and higher doses of glyphosate; and use of older more toxic herbicides in combination with glyphosate. Not surprisingly, these short-term fixes ensure a future of rising pesticide use and the further spread of weeds resistant to ever higher doses of one or more pesticides.

3.6 weed resistance on the increase in south america

The patterns of weed resistance seen in the US are being mirrored in South America and claims of reducing herbicide by planting glyphosate resistant crops are being proven false. The number of weeds being found with resistance to glyphosate in South America has been steadily increasing since 2003, and as a result, not only is glyphosate being used in greater quantities, but other herbicides are being employed in addition, bringing with them all the negative impacts already explored in this report. The environmental and social implications are massive as the continent is home to three of the world's largest producers of GM soybean: Argentina, Brazil, and Paraguay. Together they accounted for over 47% of the world's soybean harvest (Van Gelder, Kammeraat and Kroes, 2008).

TABLE 11 **USE OF LEADING HERBICIDES OTHER THAN GLYPHOSATE ON CORN AND SOY IN THE US: 2002 TO 2006**

CROP	SOYA	CORN				NOTES
Active ingredient	2,4-D	Atrazine	Acetachlor	Metalachlor/ S-metalachlor	Top corn herbicides combined	
2002	1,389,000	55,018,000	34,702,000	25,875,000	115,595,000	
2003	n.a.	60,480,000	39,203,000	27,535,000	127,218,000	
2005	1,729,000	61,710,000	32,045,000	27,511,000	121,266,000	From 2002 to 2005, atrazine use on corn increased by 12%. Use of the top four corn herbicides increased 4.9%. The 5-fold increase in glyphosate use on corn over the same time span (see last table) has clearly not displaced any of the leading corn herbicides.
2006	3,673,000	n.a.	n.a.	n.a.	n.a.	Use of 2,4-D on soy rose by more than 2.6-fold from 2002 to 2006. Over the same period, glyphosate use on soy rose 43% (see last table). Glyphosate is clearly not displacing use of 2,4-D.

Figures *= pounds of active ingredient.*
Source*: "Agricultural Chemical Usage: Field Crops Summary," USDA National Agricultural Statistics Service for the respective years. Accessible from: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1560. USDA pesticide usage figures cover only a certain percentage of the nationwide acreage planted to the given crop, a percentage which varies from year to year. In order to obtain nationwide use, we have corrected by dividing total reported use of the respective herbicide by the percentage of the nationwide crop acreage for which pesticide usage data was reported. n.a. = not available, note that USDA does not report pesticide usage for all crops in all years.*

three the rise in pesticide use

continued

3.6a gm soy in argentina

Weeds have become a serious problem in Argentina. In 1996/7, Roundup Ready soybeans accounted for a mere two per cent of its total soybean crop, but by 2007 that figure had almost reached 100%. Monsanto claimed it was "unlikely that resistant plants will appear over time in a weed population" due to "the mode of action unique to glyphosate" (Monsanto, 21 April 1997), but Argentine farmers and the country as a whole are now suffering badly from a serious epidemic of resistant weeds.

johnsongrass (Sorghum halepense) is a monocot weed in the Poaceae family and is considered one of the worst weeds in the world. It was already classed a problematic weed in Argentina during the 1930s (Passalacqua, 2006; Leguizamón, November 2006; Olea, 2007). Farmers first reported failure to control johnsongrass with glyphosate in the late 1990s[51] (Valverde & Gressel 2006), though according to Monsanto, the first complaint of glyphosate-resistant johnsongrass was received in December 2003. In 2004, various field tests conducted by the company suggested that older weeds i.e. johnsongrass were more resistant to glyphosate than younger ones; and that some weeds tolerated up to 3.5 times the normal dose of glyphosate (Valverde & Gressel, 2006). Argentine agricultural officials at the National Service of Agriculture, Food & Health and Quality (SENASA) delayed any action on the matter, and when a report was finally commissioned two years later, completed by agricultural consultants Jonathon Gressel and Bernal Valverde, the results were terrifying: "the field data leave no doubt that resistance has evolved. Resistance seems widespread in Salta and a focus has been detected in Tucuman. Unconfirmed reports suggest that the situation in Tucuman is much worse and that there are already spreading resistant populations in Rosario," (Valverde & Gressel 2006). By October 2007, SENASA estimated that 120,000 hectares of land were infected with glyphosate resistant johnsongrass, a hundred-fold increase on the previous year (Olea, 2007; Sellen 2007).

As in the US, the major recommendation to control resistant weeds is to use a cocktail of herbicides other than glyphosate, including more toxic weedkillers such as paraquat, diquat and triazine herbicides such as atrazine (Valverde & Gressel, 2006). It is estimated that an additional 25 million litres of such herbicides will be needed each year to control resistant weeds, resulting in an increase in production costs of between \$160 to \$950 million per year (Proyecto de Ley, 19 September 2007). SENASA agricultural expert Daniel Ploper estimates that herbicide costs will double in the affected areas (Sellen, 2007).

The only conclusion that can be drawn is that the expansion of Roundup Ready soya monocultures – from 2% to almost 100% - has led to an explosion in the use of glyphosate as well as other herbicides to counter its impotency.

3.6b gm soy in brazil

As in Argentina, Brazilian researchers from the Brazilian Agricultural Research Corporation, EMBRAPA, recently admitted the existence of four glyphosate-resistant weed species which have "a great potential to become a problem" (Cerdeira et al, 2007), particularly in Rio Grande Do Sul where the adoption of RR soya is almost 100%. Farmers have been blamed for the rapidly decreasing efficacy of glyphosate, despite those truly responsible being the seed and chemical companies who push unsustainable models of pesticide-promoting GM crops (Gazeta Mercantil, 9 August 2007).

According to a 2006 study by EMBRAPA, Brazil has witnessed a 700% increase in the use of agrochemicals over the last 40 years (EMBRAPA, December 2006). This has been caused by the prominence of soy, becoming Brazil's principal crop, and more specifically the reliance of Roundup Ready soybeans on glyphosate, whose use increased 79.6% during the period 2000-2005 (See Figure 5). Not only is this seriously harming the environment, but farmers are being squeezed by rising costs specific to GM crops. According to an analyst from Agra-FNP, Fábio Turquino Barros, the price of herbicides for GM soya in Mato Grosso, the biggest soy-producing state in Brazil, had risen by 44% by the end of 2007, while the price of herbicides used on conventional soya has declined by 45% from the 2006/07 season.

In Paraná, the trend for adopting GM soya appears to be changing as the high input costs and reduced performance make GM soya less attractive. The Secretary of Agriculture of Paraná, Valter Bianchini, said that of all seed bags available for the 2008/09 crop, 58% were conventional compared to last year's 48% conventional (Agência Estadual de Notícias do Paraná, 18 December 2008). This lower use of genetically modified soy is reflected in the lower usage of pesticides. Data collected by IBAMA between 2000 and 2005 shows the increase in glyphosate use much lower in Parana (7%) than states which have embraced GM soya: Mato Grasso has experienced a 94% increase in glyphosate use during the same period (Valor Económico, 24 April 2007).

TABLE 12 **WEED RESISTANCE TO GLYPHOSATE IN SOUTH AMERICA**

CROP	WEEDS RESISTANTE TO GLYPHOSATE IN ARGENTINA	COMMON NAME	YEAR	MODE OF ACTION
1	Lolium multiflorum	Italian Ryegrass	2007	Glycines
2	Sorghum halepense	Johnsongrass	2005	Glycines
3	Sorghum halepense	Johnsongrass	2006	Glycines
	WEEDS RESISTANT TO GLYPHOSATE IN BRAZIL			
1	Digitaria insularis	Sourgrass	2008	Glycines
2	Conyza canadensis	Horseweed	2005	Glycines
3	Conyza canadensis	Horseweed	2006	Glycines
4	Conyza bonariensis	Hairy Fleabane	2005	Glycines
5	Conyza bonariensis	Hairy Fleabane	2005	Glycines
6	Euphorbia heterophylla Multiple Resistance	Wild Poinsettia	2006	ALS inhibitors Glycines
7	Lolium multiflorum	Italian Ryegrass	2003	Glycines
	WEEDS RESISTANT TO GLYPHOSATE IN PARAGUAY			
1	Digitaria insularis	Sourgrass	2008	Glycines
2	Digitaria insularis	Sourgrass	2006	Glycines

***Source**: "Based on Weedscience (Last accessed 15 October 2008)*

3.6c pesticide use in uruguay

Pesticide use has continued to soar in Uruguay. Between 2003 and 2007, herbicide use doubled (Oyhantçabal, December 2008), mainly met by imports, which according to the Uruguayan Agricultural Department report tripled, from 2001 to 2007 (DGSSAA, 2008).

In the 2008 edition of Who Benefits from GM crops?[52] the appearance of three new weeds resistant to glyphosate in Argentina and in Brazil were recorded. Just one year later, two new cases of resistance – in this case sourgrass - were confirmed, this time in Paraguay and Brazil. The problem is likely to be far worse since, as we mentioned before, the figures include only documented resistance and exclude numerous field reports of suspected weed resistance.

Soybeans.

Soya field with Roundup transorb label, a herbicide produced by the US company Monsanto, Rio Grande do Sul, Brazil.

four there is a better way

there is a better way

GM crops cannot solve the crisis of increasing poverty and hunger, and rising environmental damage. However, alternatives have been put forward that take into account climate change, livelihoods for small farmers, the need for long-term sustainability and for equitable distribution of the benefits of any improvements in yields. Amid biotech industry calls to look again at GM, an internationally endorsed study has advocated returning to smaller scale farming using less-expensive methods. Another study of farming trials in Africa have shown that organic farming methods are doing just that with great success.

4.1 global agricuture assessment advocates non-gm

The first International Assessment of Agricultural Science and Technology for Development (IAASTD) has found that the best way to fight global hunger is not through an increase in GM crops, but through a return to biologically diverse farming methods. The four-year assessment – sponsored by the UN, World Bank, World Health Organisation and conducted in the name of 58 countries – engaged 400 experts from industry, government, academia and the public interest community to chart out the most promising paths for poor countries to increase their food security (The Guardian, 2008).

The multi-disciplinary report called for a fundamental shift in the way agricultural knowledge, science and technology (AKST) was thought of and realised, redirecting it towards those who have previously benefited least. According to IAASTD, "AKST can be used to reduce hunger and poverty, to improve rural livelihoods and to facilitate equitable environmentally, socially and economically sustainable development"; GM crops on the other hand were shown to hold very little potential in alleviating poverty and hunger with, at best, "variable" yields'. The biotech industry pulled out of the assessment just months before its completion, upset by the poor ratings of their technologies. An editorial in scientific journal Nature accused them of "deserting the hungry" (Nature, 2008).

The approaches favoured by IAASTD included agro-ecological farming techniques, emphasising how agriculture offers more than food, fibre, raw materials and biomass, for instance providing ecosystem services and functions, and affecting landscape and cultures. It also acknowledged the key role that the local knowledge held by farmers, particularly women, and other small-scale food producers should play in developing appropriate technologies and knowledge systems. It recognised that past technological innovations and trade had failed to benefit poor people and had harmed the environment, and called for a reduction of agricultural subsidies in rich nations and a reform of unfair trade rules.

Agro-ecological farming techniques include the innovative management of soils, water, biological resources, genetic diversity, pests and disease vectors, and the conservation of natural resources in a culturally appropriate manner. Adopting these techniques – combined with the promotion of small-scale farming – would provide a powerful tool in creating sustainable agricultural development, wider employment opportunities, enhanced rural livelihoods and ultimately greater yields, thereby reducing hunger and poverty.

The IAASTD recognised that the way forward must be through localised farming solutions, combining scientific research with traditional knowledge in full partnership with farmers and citizens. Improving the understanding of organic farming techniques means greater efficiency and diversification. Such measures will also help combat climate change.

The report also called for a reform of international trade so that smaller countries can balance the needs of poor consumers and small-scale producers. The IAASTD concluded that this could bring wider and more long-lasting benefits to the poor and hungry than GM technology.

4.2 un reports show organic small-scale farming can feed the world

A major study by UN agencies has concluded that organic farming offers Africa the best chance of breaking the long inherent cycle of poverty and malnutrition. The study undertaken by UNCTAD and UNEP published in 2008 examined over a hundred cases of organic and near organic agriculture in Africa (UNCTAD-UNEP, 2008). The paper focused on attaining food security for the majority of the chronically hungry who are small farmers in developing countries producing much of what they eat, and who are often too poor to purchase inputs and who are marginalised from product markets. Although special attention was given to Africa, the authors specify that the conclusions and findings are relevant for many other developing countries around the world.

The results of the study conclude that organic agriculture "can increase agricultural productivity and can raise incomes with low-cost, locally available and appropriate technologies, without causing environmental damage".

The analysis found that yields more than doubled when organic, or near-organic practices were used and that organic farming showed increases in per hectare productivity for food crops, increased farmer incomes, environmental benefits, strengthened communities and enhanced human capital. The head of UNEP, Achim Steiner, said the report "indicates that the potential contribution of organic farming to feeding the world may be far higher than many had supposed" (The Independent, 2008).

some of the main conclusions of the study:

- *Organic agriculture can increase agricultural productivity and raise incomes with low-cost, locally available and appropriate technologies, without causing environmental damage.*
- *All of the case studies which focused on food production showed increases in per hectare productivity of food crops, challenging the popular myth that organic agriculture cannot increase agricultural productivity.*
- *Organic and near-organic agricultural methods and technologies are ideally suited for many poor, marginalised smallholder farmers in Africa, as they require minimal or no external inputs and use locally and naturally available materials to produce high-quality products.*
- *The recent food-price hike and the effect of rising fuel prices have highlighted the importance of making agriculture less dependent on energy and external inputs. Enhanced transition to sustainable forms of agriculture in general, and organic agriculture in particular, provide an effective response strategy to escalating food prices.*
- *Mono-cropping farming systems intended for export markets, whether conventional or organic, leave farmers vulnerable to export price fluctuations and crop failure.*
- *Organic agricultural systems make a significant contribution to reducing food insecurity and poverty and to improving rural livelihoods in areas of Africa. There is the potential to do more in this area with enabling policy and institutional support.*
- *More information on agro-ecological technologies is needed. However this requires a shift of emphasis in research and science budgets, and the creation of better linkages between scientists, agricultural training and farmers.*

4.3 experiences from east africa involving small farmers:

- *The Manor House Agricultural Centre in Kenya trains people in sustainable agriculture practices. In 2005, it was estimated that around 70,000 Kenyans had been trained, and many of those have doubled their yields by adopting digging, composting and using local natural methods of pest and disease control. Also in Kenya, the Community Mobilization against Desertification programme works with about 500 farmers on around 1,000 ha and has increased maize yields from 2 to 4 tonnes/ha. The programme has been active in western Kenya where there is only one rainfall season and where the land is in very poor condition due to overgrazing and deforestation.*
- *Again in Kenya, the International Centre of Insect Physiology and Ecology (ICIPE) has designed low-cost integrated pest management technology, which it is working with farmers to develop and test (Koechlin, F. 2002; UNCTAD. 2008). ICIPE has developed a push-pull strategy that reduces the incidence of stemborers by trapping pests on trap plants (pull) and then driving them away from the crop using a repellent intercrop (push). ICIPE has trained a network of farmer-teachers and estimates that over 3,000 farmers have adopted the push-pull technologies (UNCTAD. 2008). Trials of this technology have so far shown important increases in maize yield. The push-pull strategy is an example of an integrated solution to the problems of the stemborer and striga. Stemborers can destroy up to 80% of the crop in no time, while the loss of crops due to striga varies from 20 to 80%.*

Organic gardens run by women in Samba, Senegal.

four there is a better way

continued

box 5 the push-pull system

The stemborer is attracted to napier-grass (Pennisetum purpureum) outside the field and repelled by desmodium (Desmodium uncinatum) inside the field. This "push-pull" system was originally developed from the knowledge that stemborers must have been indigenous to East Africa long before maize was introduced (about 100 years ago). Originally, its host must have been different kinds of wild grass and only later on did it specialise in maize, which had no resistance against it and was more nutritious.

For four years, scientist Zeyaur R. Khan and his team selected several species of wild grass with strong stemborer-attracting odours and cultivated them in a garden near the station. Local farmers were invited to choose from the different varieties: they mostly preferred Napier- and Sudan-grass, which both look very similar to maize and are good fodder. Varieties of wild grass looking more like weed were passed over.

The selection of repellent-plants was successful: molasses-grass (Melinis minutiflora) reduced the loss of crop from 40% to 4 - 6%. The silver-leafed desmodium is a good stemborer-repellent, with the added advantage of being a soil-enriching, nitrogen-fixing legume that keeps the soil moist and protects it from erosion. Most importantly, desmodium is most effective against Striga. With desmodium, striga is suppressed by a factor of 40 compared to a maize monocrop. Although pink flowering striga is a very beautiful weed, it is a deadly plant that lives on maize roots and spreads easily with a single plant producing 20,000 tiny seeds that disperse easily. (Source: Koechlin, F. 2002)

- *In Uganda organic cotton production has increased significantly from 200 farmers to 24,000 by the year 2000. The majority are small-scale resource-poor farmers, who used traditional cultural practices such as fallowing, crop rotations and natural pest control. Thanks to this interest several areas in Uganda are exempt from pesticide promotion campaigns and some districts are now promoting organic agriculture.*
- *In South-west Ethiopia, an area that was once entirely dependent on emergency food aid is now able to feed itself and even grow a surplus. Some 12,500 farm households have adopted sustainable agriculture practices on around 5,000 ha. The project introduced new varieties of crops and trees and promoted organic manure for soil fertility. This resulted in a 60% increase in crop yields and a 70% improvement in overall nutrition levels within the targeted area (UNCTAD. 2008).*

Below: Difference between maize grown with push-pull method (b/g) & without. (f/g, left). Suba District, Kenya. Right: Self-help project to support Rusinga Island with help from ICIPE field station Mbita Point, Kenya. Far right: Organic farmer in Samba, Senegal.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five europe: gm crop cultivation declines

europe: gm crop cultivation declines

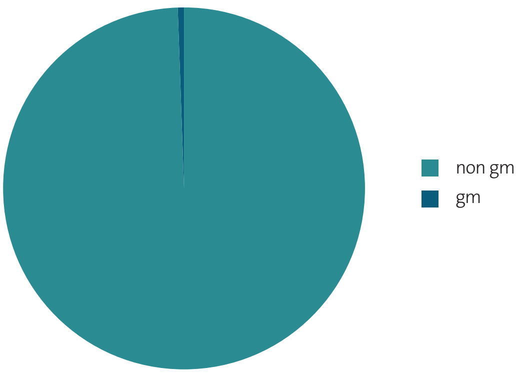
GM crops make up a tiny percentage of arable land[53] (0.36%) and of all agricultural land[54] (0.21%) in the EU[55] (see figures 10 and 12 and table 13).

In 2008, the overall area under GM crop cultivation in the EU dropped. This was because France banned Monsanto's Bt maize MON810 on health and environmental grounds.[56] As a result the overall surface area under GM cultivation in the EU fell by two per cent to 107,719 hectares.[57]

Only seven countries (as opposed to eight in 2007) out of the twenty seven European Union member states grow GM maize (see text box 2), the only GM crop allowed to be grown in the EU – Monsanto's Bt maize, MON810.[58] As well as France, four other EU countries have also banned this GMO.[59]

Public opinion remains opposed to GM food[60] and EU governments remain split on whether to authorise GMOs in the EU.

FIGURE 10	% ARABLE LAND IN THE EU27*



*: *The area under GM crop cultivation in the EU remains tiny. See table 4 for figures.*

box 6 biotech industry falsely claims increase in gm crop cultivation in 2008

The cultivation of GM crops in Europe in 2008 has been so dismal that the biotech industry had to cook the books. In September 2008, the European biotech lobby association claimed that GM crop cultivation in the EU this year was showing "a 21% increase over 2007".

But rather than comparing the eight countries growing GMOs in 2007 with the countries growing GMOs in 2008, EuropaBio just dropped France from its calculations therefore ensuring that the net decrease in area under cultivation simply disappeared(see figure 11 and tables 13 and 14).

The benefits of this kind of manipulation were apparent when a couple of months later, the President of the European Commission's office quoted the false figure as a justification for the "growing interest in using GMOs in the EU" (http://www.foeeurope.org/GMOs/sherpas/Sherpa_meeting_10oct_conclusions.pdf)

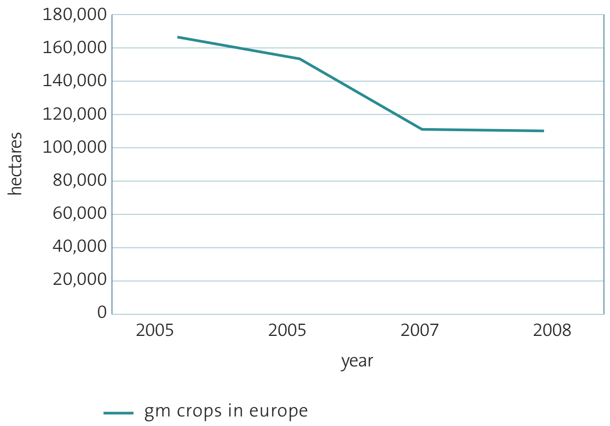
Industry figures also show that when looking at all European countries (EU 27 plus Romania which joined the EU in 2007) to have grown GM crops in the last four years, there is in fact a 35% decrease. This is due to Romania stopping growing GM soy as a requirement of joining the EU (GM soy is not authorised for cultivation in the EU), and to France banning MON810 in 2008.

(EuropaBio, "EU Biotech cultivation in 2008")

five europe: gm crop cultivation declines

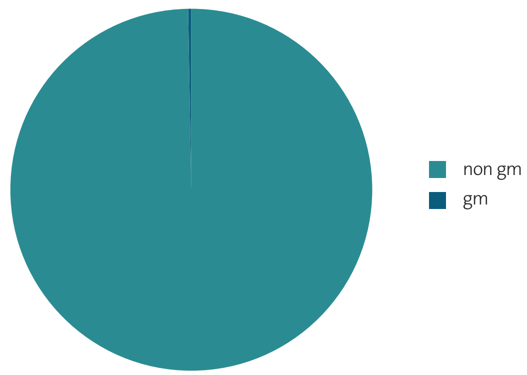
continued

FIGURE 11 **GM CROPS CULTIVATED IN EUROPEAN COUNTRIES 2005-08***



*: *See table 2 European countries growing GM crops for figures*

FIGURE 12 **% EU AGRICULTURAL LAND***



*: *See table 3 for figures.*

TABLE 13 **INDUSTRY'S FALSE CLAIMS: 21% INCREASE IN THE EU IN 2008, 50.6% INCREASE IN EUROPE OVER 4 YEARS***

COUNTRY/YEAR	2005	2006	2007	2008
Spain	53,225	53,667	75,148	79,269
France	492	5,000	21,147	-
Czech Republic	150	1,290	5,000	8,380
Portugal	750	1,250	4,500	4,851
Germany	400	950	2,285	3,173
Slovakia	-	30	900	1,900
Romania	110,000 (Soybean)	90,000 (Soybean)	350 (Maize)	7,146 (Maize)
Poland	-	100	320	3,000**
Total (NB without France and without Romania in 2005 and 2006)	**54,525**	**62,187**	**88,903**	**107,719**

***:** *Figures presented by the European biotech lobby group EuropaBio (in hectares)*
***Source:** "EU biotech cultivation in 2008: 21% increase in 2008" EuropaBio 2008.*
Romania is not counted as was not a member of the European Union before 2007. However, in terms of GM crops grown in Europe (as opposed to the EU), there is a decrease of 35% over the 4 years (see table 14 and figure 11)

TABLE 14 **WHAT THE FIGURES REALLY SAY: 35% DECREASE IN EUROPE OVER 4 YEARS, 2% DECREASE IN 2008 FOR THE EU**

These are the figures when France and Romania are included and the totals are correctly added up. It is evident that there has been a yearly decrease in the area under GM cultivation for the last four years, including a two per cent decrease in 2008. The sharp decrease in figures for 2006-2007 was due to Romania stopping growing GM soy. On joining the EU in 2007, Romania had to stop growing GM soy as this was not authorised for EU member states. The decrease from 2005-2008 is therefore for Europe as a whole. No other European countries have grown GM crops.

COUNTRY/YEAR	2005	2006	2007	2008
Spain	53,225	53,667	75,148	79,269
France	492	5,000	21,147	-
Czech Republic	150	1,290	5,000	8,380
Portugal	750	1,250	4,500	4,851
Germany	400	950	2,285	3,173
Slovakia	-	30	900	1,900
Romania	110,000 (Soybean)	90,000 (Soybean)	350 (Maize)	7,146 (Maize)
Poland	-	100	320	3,000
Total	**165,017**	**152,287**	**109,650**	**107,719**

***Source:** "EU biotech cultivation in 2008: 21% increase in 2008" EuropaBio 2008 but with correct totals!*

TABLE 15 GM CROPS AS A PERCENTAGE OF AGRICULTURAL LAND

	TOTAL AGRICULTURAL LAND HA[61]	TOTAL GM CROPS HA[62]	GM AS PERCENTAGE OF TOTAL
Global	4,803,385,400	114,300,000	2.4%
27 EU countries' agricultural land	192,276,000	400,000	0.21%
23 global GM countries' agricultural land	2,494,141,000	114,300,000	4.5%

Source: *GM Freeze, June 2008****
*** http://www.gmfreeze.org/uploads/GM_crops_land_area_final.pdf*

TABLE 16 GM CROPS AS A PERCENTAGE OF ARABLE LAND

	TOTAL ARABLE LAND HA[63]	TOTAL GM CROPS HA[64]	GM AS PERCENTAGE OF TOTAL
Global	1,365,069,800	114,300,000	8.4%
27 EU countries' arable land	110,849,000	400,000	0.36%
23 global GM countries' arable land	745,685,000	114,300,000	15.3%

Note: *Table 2 shows the percentage of arable* land under GM crops.*
Source: *GM Freeze, June 2008***
*** Arable land includes land used for annual crops, such as soya and wheat. Not including permanent crops such as orchard and vineyards. www.nationmaster.com/graph/agr_ara_lan_hec-agriculture-arable-land-hectares taken from http://www.gmfreeze.org/uploads/GM_crops_land_area_final.pdf*
**** http://www.gmfreeze.org/uploads/GM_crops_land_area_final.pdf*

box 7 cultivation of gm crops in europe at a glance:

- *In the EU, GM crops make up a tiny percentage of arable land (0.36%) and of all agricultural land (0.21%)*
- *GM crop cultivation in the EU decreased in 2008 compared to 2007*
- *Only one GM crop is authorised for cultivation in the EU, Monsanto's Bt maize, MON810*
- *Five EU countries have banned MON810 on environmental and health grounds, most recently France, one of the leading agricultural countries in the EU*
- *Only seven out of the twenty seven EU member states grow MON810 (one less than in 2007): Spain, Czech Republic, Germany, Slovakia, Poland, Romania, Portugal*
- *In Poland, MON810 maize is in fact grown despite a national ban. This is because whilst selling the seeds in Poland is illegal, Monsanto and the Polish Biotech Lobby Association have given farmers contact addresses in Germany, the Czech Republic and Slovakia where they can buy the seeds. In 2008, there were an alleged 3,000 hectares of this illegal maize grown*
- *Industry figures show that the total area under cultivation in European countries has decreased year by year since 2005 and an overall 35% over the last four years. Part of this reason is because Romania stopped growing GM soy once it joined the EU in 2007 as this is not authorised in the EU (see table13). (http://www.europabio.org/documents/2008%20Cultivation%20chart.pdf).*
- *Total GM cultivation in the EU in 2008 dropped to 107,719 hectares compared to 110,007 hectares in 2007, a decrease of just over two per cent. (http://www.europeanvoice.com/article/2008/09/drop-in-genetically-modified-crops-grown-in-eu/62491.aspx)*
- *As well as being tiny, the area under GM crop cultivation in the EU is essentially contained in one single country: just under three quarters of EU GM crop cultivation (74%) is found in Spain (http://www.gmo-compass.org/eng/agri_biotechnology/gmo_planting/191.gm_maize_110000_hectares_under_cultivation.html).*
- *None of the other European countries outside of the EU grow GMOs (e.g. Norway, Switzerland, Iceland, Serbia, Montenegro, etc). Switzerland has a moratorium on growing GM crops in place until 2012. States that are at various stages in EU accession talks such as Turkey, Croatia and Macedonia do not grow GMOs.*

five europe: gm crop cultivation declines

continued

5.1 gm crop cultivation in europe: negligible and of uncertain benefit to farmers

As mentioned above, GM crop cultivation represents less than two per cent of EU maize. Just under three-quarters of this is from just one country, Spain. GM maize is mainly grown in the regions of Cataluña and Aragon.[65] Since GM maize was first authorised more than 10 years ago, the surface area in Spain under Bt maize cultivation has reached 18% (overall maize production in Spain is 379,000 hectares) (IPTS-JRC, 2008).

The European Commission uses the case of Spain to argue that GM crops can be grown successfully in the EU, and in particular that "coexistence"[66] works. The biotech industry[67] also uses Spain to show how coexistence is "not a problem" and has organised visits to Spanish GM farms to promote the growing of GM crops.[68]

However, what both the European Commission and the biotech industry omit to mention is that there are no labelling or traceability schemes in Spain. This means that farmers have no legal protection or right to compensation against GM contamination. This is despite a decision at EU level that countries need to adopt coexistence measures to ensure that organic and GM-free conventional farming, as well as consumer choice, is not put at risk.

Research conducted by Greenpeace Spain and the Assemblea Pagesade Catalunya & Plataforma Transgenics Fora in 2005/6[69] has revealed that the lack of traceability measures means that most cooperatives in the GM growing areas do not treat conventional and genetically modified maize differently during transport, reception, drying storage or sale. This means that all the maize is sold specified as GM (the food sector generally requires non-GM) and labelled as such. As a result it is impossible to buy non-GM stockfeed. Coexistence therefore only "works" because contamination is generalised.

The Greenpeace and partners' report compiled seven cases of GM contamination of maize growing in farmers' fields in Cataluña and Aragon. The contamination with GM ranged between 0.07% and 12.6% and involved two Bt insect resistant varieties of maize, Monsanto's MON810 and Syngenta's Bt176 (now discontinued). Both organic and conventional maize varieties were affected. However, because of the lack of government monitoring and the financial and administrative structures needed to do this properly, it is likely that most contamination incidents go unreported. A voluntary agreement between government and companies to limit Bt maize cultivation to small areas expired in 2002 increasing the risk of contamination.[70]

5.1a agronomic impacts of bt maize in spain

Two species of corn borer are present in Spain but it is widely accepted that this is in general a minor problem. The Spanish government's own working group on pesticides reported in 2002 that corn borer incidence in Spain was "low" and "does not justify the use of these GM varieties" (Spanish Ministry of Agriculture, 2002). Prior to the adoption of Bt maize in Spain, the use of insecticide against the European Corn Borer (ECB) was limited with only an estimated five per cent of the corn belt treated.[71]

Furthermore, damage from borers depends on a variety of factors, including location, year, climatic factors, timing of planting, whether insecticides are used or not and the timing of application.

Yield is a complex phenomenon that depends on numerous factors, including weather, availability of irrigation and fertilisers, soil quality, farmers' management skills, and the level of pest infestation. As in other countries that grown Bt crops, Bt maize yield varies in Spain and no reports so far have been able to conclude clear yield improvements.

In 2008, the European Commission's research body – part of the Commission's DG Research – published what it hailed as "the first large-scale empirically-based estimation of the economic impact of a GM crop for EU farmers"(IPTS, 2008).

The study reports that any yield improvement that Bt farmers may experience directly translates into an increase in revenue. However, this is because of the lack of contamination laws, and the fact (mentioned above) that the cooperatives mix non-GM and GM together, label it all as GM. Non-GM farmers cannot receive a price premium for producing non-GM maize as happens in other parts of the world.

The study also claims that the higher costs of Bt maize seeds do not have a negative impact on farmers because in regions where there are very small or no yield gains with Bt maize, the seed companies have reduced the price of seeds. This indicates that increased yield is far from confirmed and that Monsanto and seed companies are so keen to get Bt crops on the market that they will drop prices.

GM maize.

5.2 importing and processing gmos in the eu

5.2a european ministers call for strengthening of gmo risk assessment

When a company wants to obtain the right to commercialise a GM crop (generally for import and processing, but also for cultivation), EU GMO laws stipulate that a risk assessment is carried out.

In December 2008, Environment Ministers from the 27 Member States called for improvements to these assessments. Member States met over a period of six months up until December 2008, to discuss what changes were needed and concluded that, in some respects, existing risk assessments do not fulfill EU legal requirements, particularly for long-term environmental and health impact assessment.

Ministers also recommended that the European Food Safety Authority (EFSA) - the EU agency responsible for risk assessment - consider the environmental impact of herbicide spraying on GM crops. Ministers stated that pesticide-producing GM crops (Bt crops) should be treated in the same way as chemical pesticides. They also agreed that data on socio-economic impacts and agronomic sustainability – referred to in EU GMO laws but until now never implemented – should be reported on by June 2010. They also recognised the right of regions and local communities to establish GM-free zones.

These conclusions are a clear indication of the importance given by European governments to a wide impact assessment of GM crops, and the need to address key issues such as pesticide use in an independent manner.

box 8 main conclusions of environment ministers on gmo assessments in the eu december 2008

- *GMO assessments in the EU do not fulfill all legal requirements*
- *Long-term impact assessments on health and the environment need to be carried out*
- *Pesticide producing GM crops (Bt crops) should be treated in the same way as chemical pesticides*
- *Data on socio-economic impacts and agronomic sustainability should be compiled and a report published no later than June 2010*
- *The right of regions and local communities to establish GM-free zones was recognised*

5.2b president of the european commission reveals his pro-gm colours

In summer 2008, José Manuel Barroso, the Head of the European Commission, wrote to the Heads of State and governments of all EU Member States asking them to send a "political" representative to Brussels to be a part of a working group on GMOs, also known as the "Sherpa" group. This group consists of high ranking officials and is chaired by Barroso's Head of Cabinet, Mr Joao Vale de Almeida. The membership of this group is not public, nor is its workplan, objectives, or the outcomes of its meetings. However, conclusions of the meetings written by Mr Barroso's head of cabinet have been obtained by Friends of the Earth Europe.[72] These papers clearly demonstrate that this group is looking at how to force more GM crops into the EU at a faster rate.

By taking this initiative, the President of the Commission has bypassed not only his own Commissioners for Environment, Agriculture and Health, but also national Ministers who are responsible for the GMO issue. Barroso's initiative was launched as the French EU Presidency started its review of GM crop assessment (see section 2 above) and is widely considered to have been an attempt to influence the conclusions reached by EU Environment Ministers.

At Sherpa group meetings, Barroso's office has raised speeding up the approvals process for GMOs to bring the EU more in line with the US. This follows US complaints that the average 2.5 years the EU takes to approve a GMO is too slow. The biotech industry and other GM proponents in Europe say that this means that the EU lags behind the rest of the world (see section 5.2c below)

The leaked documents show Mr Barroso's office stating that:

- *The public is "ill informed" about GMOs.*
- *EU GMO laws for imports and the rate of GMO approvals are a "threat to agriculture". This ignores all evidence to the contrary (see section 5.2c below)*
- *That there is a "growing interest in using GMOs inside the EU" because Mr Barroso's office have relied on the industry's false figures comparing 2007 with 2008 (see text box 1)*

The Sherpa's second and most recent meeting in October 2008 ended with a clear steer for participants to talk to their Heads of State and governments to "have a richer debate". Participants were reminded that Environment Ministers were due to reach conclusions on GMO assessments in the EU in a move that seemed to invite representatives of heads of governments to influence the outcomes of Environment Ministers' review of GMO assessments (see section 5.2a). Environment Ministers did not bow to pressure and in some Member States, national governments also responded indignantly to Barroso's efforts.

five europe: gm crop cultivation declines

continued

As this report goes to print, it is not yet clear what Barroso plans next – the leaked documents indicate that a second letter to heads of government will be sent with information on next steps. The biotech industry clearly have a friend in the President of the European Commission, who appears to be acting with little democracy or transparency in order to promote GM crops over the heads of competent ministers and against the wishes of the majority of Europeans.

5.2c biotech industry scaremongering on eu import rules

Over the last couple of years, the biotech industry has been lobbying for the EU to drop "zero tolerance" and to stop "asynchronous approvals". "Zero tolerance" is the EU policy whereby any imports that are found to be contaminated even with trace amounts of a GMO that has not been approved in the EU, cannot enter the European Union. The term "asynchronous approvals" is used to define how the EU approves GMOs more slowly than the US which approves GMOs faster than any other country in the world.

The 2008 global food and feed price increase has been used to push for these changes: while the increase in prices was beneficial for farmers growing agricultural commodities, it was harder for buyers such as the animal feed industry, oilseed industry and livestock farmers. The feeling of urgency linked to the steep increase in prices was used to blame EU GMO laws for the woes of the livestock sector.

5.2d false alarm: the case of roundup ready 2

In 2007/8, lobbyists started claiming that Latin American countries were about to commercialise Monsanto's new genetically modified soy - RoundUp Ready Soy 2 (referred to as MON88197). Monsanto had already gained approval in the US to grow RR2 and the concern was that as the GMO had not been granted import authorisation yet in the US, if all major exporters to the EU started to grow RR2, low levels of contamination would be inevitable and there would be a real risk of imports being blocked at port, leading to livestock farmers and animal feed importers losing their livelihoods, and animals going hungry.

box 9 Bob Stallman, president of the American Farm Bureau Federation speaking to the UK National Farmers' Union conference 2008. (The NFU is the UK member of EU farming lobby group COPA COGECCA)

"I think the debate about higher prices and being able to meet the demand of people in the world for food is a perfect opportunity to make the case (for GMO crops)...We may have a window of opportunity here and I would encourage you to exploit that" (EuropaBio, "EU Biotech cultivation in 2008"

However, what the lobbyists omitted was that Monsanto had not in fact put in a request to commercialise RR2 in either Brazil or Argentina. Given that the time taken to approve GM crops in Argentina and Brazil varies between three and five years, cultivation of RR2 was clearly not imminent in either country.

Even if the US started growing the crop on a large-scale, its imports to the EU have been steadily declining over the last ten years because of *"a decline of competitiveness of US agriculture on the global market"*.[73] Indeed, the European Commission stated that "If the EU non-approved GM soybeans were cultivated only in the USA, but not in Argentina and Brazil, the impact on the EU market of a ban on US supplies would be small due to the moderate US import volumes." There was clearly no problem posed by 'imminent' RR2 cultivation.

5.2e "asynchronous" approvals: the shrinking of us market opportunities

In terms of the time taken to approve new GMOs onto the market, the EU has been identified by the US and industry lobbyists as a problem. The European Commission's DG Agriculture states that the EU takes at least 2.5 years to approve a GMO[74] and the approval time is becoming shorter. Brazil and Argentina – two of just a handful of GM producer countries – take longer than the EU: an average of five and three years respectively. The US in fact authorises GMOs much quicker than any other region of the world and does not have any significant

box 10 time taken to approve gm crops in the world: comparison with gm producer countries and the eu

Brazil – 3-5 years – includes analysis of export opportunities to see if major export markets will import the GMOs – ability to export to the EU within zero tolerance rules confirmed

Argentina – 3 years - includes analysis of export opportunities to see if major export markets will import the GMOs – ability to export to the EU within zero tolerance rules confirmed

United States – 15 months, no safety assessment to speak of and no analysis of export opportunities. This has contributed (the other factor is cost) to the EU now getting the vast majority of its animal feed from Latin American countries

Conclusion: the US approves GMOs much quicker than other main producer countries. No attention is paid to potential export markets resulting in the US being essentially barred from exporting to the EU. Other producer countries approve GMOs more slowly than the EU.

It is therefore the US which is isolated and not the EU safety assessment requirements. In addition, the US has no measures in place for traceability to prevent contamination which contributes to its inability to guarantee that exports can meet EU standards.

box 11 why gmo laws do not need to be weakened: key points

- *Main supplier countries to the EU are Argentina and Brazil*
- *Soy and maize grown in the US is no longer exported to the EU as Brazil and Argentina are more competitive and take EU GM authorisations into account*
- *These two countries analyse export market before commercialising a new GMO*
- *They have so far never authorised a GMO prior to the EU*
- *Although it was claimed that Monsanto's RR2 was about to be grown in Brazil and Argentina, Monsanto had not submitted a commercialisation request in either country*
- *Time taken to authorise a GMO in Europe is at least 2.5 years, 3 years in Argentina and 3-5 years in Brazil. At 15 months, it is therefore the US that is isolated because of the speed in which it authorises new GMOs*
- *US industry has developed a scheme to establish export market possibilities as a result of GM contamination problems.[75] BIO is now urging its members to respect the scheme to prevent contamination incidents. If such rules were made obligatory by the US government, then US farmers' and exporters' markets would be protected and EU GMO laws would not be a threat.*

5.2f export market potential: a requirement of gmo authorisation processes

Argentina and Brazil both have requirements that export market potential is analysed before authorisation is granted for a new GMO. This step is to ensure that they do not authorise a GMO that is not allowed in key export markets, such as the EU.

The US had similar measures in place, until 2008, which were known as "Market Choices" and had in fact been developed by Monsanto to "help growers and grain handlers identify non-EU approved" crops and "remind growers to market grain from select GMO products through approved channels" (Martin Ross, 2008).

However, not all companies followed the "Market Choices" programme and following a case of GM contamination of US maize exported to the EU in 2007,a new scheme was developed in 2008. This new scheme, called "Excellence Through Stewardship" aims to deal with the problem posed by asynchronous approvals for the US market and is run by the US national biotechnology association BIO. It emphasises the need for all member companies such as Monsanto, Syngenta etc to get approvals for a GM crop in all key export markets prior to commercialising new GM crops in the US.

Even the US biotechnology industry clearly recognises the need to take the needs of export markets into account.

If this scheme was compulsory and run at government level, like in Brazil and Argentina, US farmers and exporters would have less to fear. What is needed is regulation in the US and not a weakening of EU GMO laws.

5.3 conclusion

The EU market has resoundingly and consistently rejected GM crops. The area under GM cultivation in Europe, more than 10 years after commercialisation began, remains minute and has decreased every year for the last 12 years. In 2008, the biotech industry's European lobby association fabricated figures showing an increase in GM crop cultivation in order to mask the actual decrease caused by one of the EU's main agricultural countries – France – banning the crop.

If the biotech industry is to reach its aim of controlling all key agricultural markets, then GM crops would need to be forced into Europe. Pressure continues to mount on the EU, with accusations that GM crops are approved more slowly than in any other region in the world. EU GMO laws for imports are also attacked with fabricated risks put forward to pressure and convince politicians, governments and the media that these laws must be dropped to save the EU livestock sector from ruin. But in reality the risk does not exist.

In fact it is the US that has becomes increasingly isolated with regard to GM crops. It grows by far the most GM crops in the world and the main global producer – Monsanto – is a US corporation. It approves GM crops faster than any other region or country in the world. GM crops are approved in the US without any significant health, environmental or export market assessment. The US has no traceability or labelling in place. This is why the US is losing out to Argentina and Brazil which have to assess market opportunities before authorising a new GM crop, and which have confirmed that they can continue to supply to the EU in accordance with EU rules.

six conclusions

conclusions

6.1 few crops, few countries

First introduced 13 years ago, GM crops are still confined to a handful of countries with highly industrialised, export-oriented agricultural sectors. Nearly 90% of the area planted to GM crops in 2007 was found in just six countries in North & South America, with 80% in the US, Argentina and Brazil. One country alone, the United States, plants over 50% of the world's GM crops. Just 3% or less of cropland in India and China is planted with GM crops, almost exclusively GM cotton. In the European Union, GM crop cultivation represents 0.21% of agricultural land.

Soya, maize, cotton and canola comprise virtually all of the biotech crop area worldwide, the same four GM crops that were grown a decade ago. GM soybeans and maize are used primarily for animal feed or biofuels in rich nations. Despite decades of experimentation, biotech companies have made a commercial success of GM crops with just two traits – herbicide tolerance and/or insect resistance – which offer little or no advantages to consumers or the environment. In fact, more than four out of every five hectares of GM crops in the world today are planted to varieties with herbicide tolerance, which are associated with increased use of chemical pesticides.

6.2 gm crops feed the biotech giants, not the world's poor

GM crops are not the answer to world hunger. The vast majority are not grown by or destined for the world's poor, but are used to feed animals, generate biofuels, or produce highly processed food products in rich countries.

Dramatically rising food prices in 2008 hit the world's poor hard, leading to food riots and protests in many developing countries around the world. While the global food crisis has already pushed 100 million more people into hunger and poverty, the world's largest agricultural biotechnology company, Monsanto, has profited from the situation.

With farmers in major exporting nations like the US receiving more for their crops, companies that sell seeds, agricultural chemicals and other "inputs" can charge farmers correspondingly more for these supplies. This means that hard-pressed farmers are not benefiting from higher crop prices – especially with the cost of fertilisers and fuel also rising. Monsanto, the dominant GM crop producer, is perfectly positioned to profit. It is the world's largest seed firm, holds a near monopoly in the market for biotech traits incorporated in GM seeds, and markets Roundup, the world's biggest-selling pesticide.

Monsanto has been increasing its seed and trait prices for several years. In the US, this is reflected in steep hikes of more than 50% in the average cost of soybean seed over the last two years, and a similar rise in the cost of maize and cotton seeds over the past three years. For instance, the cost of soybean seeds needed to plant one acre rose from $32.30 to $49.23 from 2006 to 2008, with further increases expected as Monsanto rolls out a new more costly version of Roundup Ready soybeans in 2009. Maize seed costs are also rising dramatically as Monsanto raises the price of its most expensive "triple-stack" GM maize varieties.

Not content with increased seed profits, Monsanto is also raising the price of its Roundup herbicide – retail prices in the US rose from $32 per gallon in late 2006 to a reported $75 per gallon in June 2008. Monsanto is also driving greater use of Roundup by incorporating the Roundup Ready trait in nearly every GM seed it sells. US farmers who once bought insect-resistant GM maize now find their favourite varieties "stacked" with the Roundup Ready trait. As a result, the area of the US planted to Monsanto GM maize seed without the Roundup Ready trait fell dramatically from 25.3 million acres in 2004 to just 4.9 million acres in 2008. This "trait penetration" strategy means higher profits from both seeds and Roundup sales.

Monsanto has used its increased revenues to continue buying up the world's seed firms, gaining ever more dominance in the global seed market. In 2008, the company purchased Netherlands-based De Ruiter Seeds Group BV for $863 million, giving it a 25% share of the world's vegetable seed market; and Guatemala-based Semillas Cristiani Burkard, the leading Central American maize seed company. The latter purchase serves Monsanto's long-term strategy of introducing GM seed to Central and Latin America, the birthplace of maize.

Monsanto's growing control of the world's seed supply ensures that farmers in any country that welcomes the company can expect the same fate as US farmers – sharply rising seed and pesticide costs, and a radical decline in the availability of high-quality conventional seeds.

Meanwhile, genetic engineering has still not increased the yield potential of any commercialised GM crop – and in the case of soybeans has been shown to lower yields. Not a single GM crop with drought-tolerance, enhanced nutrition or other attractive-sounding traits has been brought to market.

The growing dependence of the world's farmers on glyphosate-tolerant, Roundup Ready crops continues to drive increased herbicide use and an epidemic of glyphosate-resistant weeds. Glyphosate use on soybeans in the US rose 28% - from 75.7 to 96.7 million lbs – from 2005 to 2006, while use of 2,4-D, the second-leading soybean herbicide, more than doubled over the same period. Overall herbicide use on US cotton rose 24% from 2.07 lbs/acre in 2005 to 2.56 lbs/acre in 2007, primarily because of the spread of difficult to control glyphosate-resistant weeds. In Argentina, the continuing expansion of glyphosate-resistant johnsongrass driven by Roundup Ready soybean cultivation is increasing weed control costs by hundreds of millions of dollars.

6.3 the biotech industry fabricates figures and threats in the eu

The EU market has resoundingly and consistently rejected GM crops. The area under GM cultivation in Europe, more than 10 years after commercialisation began, remains just 0.21% of agricultural land. In 2008, the biotech industry's European lobby association fabricated figures showing an increase in GM crop cultivation in order to mask the actual decrease caused by one of the EU's main agricultural countries – France – banning the crop.

If the biotech industry is to reach its aim of controlling all key agricultural markets, then GM crops must be forced into Europe. Pressure therefore continues to mount on the EU, and the region is being accused of authorising GM crops more slowly than any other region in the world. EU GMO laws for imports also come under attack with fabricated risks put forward to pressure and convince politicians, governments and the media that these laws must be dropped or else the EU livestock sector will face ruin. One key part of this strategy was to falsely claim that Monsanto's new GM soy was about to be grown in the countries the EU depends on for imports of soy (Argentina and Brazil, and previously the US). In fact, Monsanto has not even filed a request for cultivation in either Argentina or Brazil. The EU livestock sector was not at risk.

In fact it is the US that has becomes increasingly isolated with regard to GM crops. It grows by far the most GM crops in the world and the main global producer – Monsanto – is a US corporation. The US approves GM crops faster than any other region or country in the world. GM crops are approved in the US without any significant health, environmental or export market assessment. There is no traceability or labelling in place. This all means that the country continues to lose out to Argentina and Brazil for access to the EU market because both of these countries have biosafety laws which include an obligation to assess market opportunities before authorising any new GM crop. Both Argentina and Brazil have confirmed that they can continue to supply to the EU in accordance with EU rules.

6.4 there is a better way

Evidence is growing to show that intensive farming, including GM crops, is not the solution for reducing poverty and hunger, or the way to tackle the increasingly urgent environmental challenges that we face globally, including climate change.

Most notably, a four-year global assessment of agriculture, the first International Assessment of Agricultural Science and Technology for Development (IAASTD), found that the best way to fight global hunger was through a return to biologically diverse farming methods. Under the auspices of the World Bank, the UN and the World Health Organisation (WHO), the assessment – also know as the World Agriculture Report – was adopted by 58 governments.

The assessment concluded that GM crops were shown to hold very little potential for alleviating poverty or hunger, with at best "variable" yields. The biotech industry pulled out of the assessment just months before its completion, upset by the poor ratings of its technologies.

The approaches favoured by IAASTD included agro-ecological farming techniques, emphasising how agriculture offers more than food, fibre, raw materials and biomass, providing for instance ecosystem services and functions, and affecting landscape and cultures. It also acknowledged the key role that the local knowledge of farmers, particularly women, and other small-scale food producers should play in the future in developing appropriate technologies and knowledge systems. It recognised the failure of past technological innovations and trade to benefit poor people and acknowledged the harm caused to the environment. The report called for a reduction of agricultural subsidies in rich nations and reform of unfair trade rules.

As environmental, economic and social costs continue to rise, we must continuously ask ourselves the question, who benefits from GM crops?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Women who run the organic garden in Samba, Senegal.

footnotes

1 Reuters 2008
2 http://www.independent.co.uk/news/uk/politics/gm-crops-needed-in-britain-says-minister-849991.html; http://news.bbc.co.uk/1/hi/talking_point/2930980.stm
3 For full discussion please see Who Benefits from GM crops, http://www.foei.org/en/publications/pdfs/gmcrops2009full.pdf
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5 FAO's State of Food Insecurity SOFI 2008
6 Miguel D'Escoto Brockmann, President of the General Assembly of the United Nations, September 2008
7 Goldman Sachs 2008
8 The herbicide Glyphosate is marketed as 'Round-up' by Monsanto, to be used along with its GM seeds resistant to Glyphosate known as Round-up Ready (RR) seeds
9 Roseboro, K. (2008). "Finding non-GMO soybean seed becoming more difficult: Fewer breeding programs for non-GMO soybeans are reducing supplies despite strong demand," The Organic and Non-GMO Report, July 2008. http://www.non-gmoreport.com/articles/jul08/non-gmo_soybean_seed.php
10 The price of GM seeds is largely determined by the number of traits they contain, with triple-stack corn seed, for example, costing significantly more than corn with two traits, which is more costly than single-trait corn. GM seeds generally cost two to four times more than conventional seeds, which are becoming ever more scarce in the seed marketplace.
11 Goldman Sachs. 2008. Monsanto Co. Company Update. Goldman Sachs Global Investment Research, June 2, 2008.
12 Goldman Sachs conservatively estimates that Monsanto's (vs. the retail) price for Roundup will increase by 38% from FY2007 ($13/gallon) to FY2008 ($18/gallon), and by 58% from FY2007 to FY2009 ($20.50/gallon), noting that "there could be some upside to our forecasts from Roundup inflation."
13 See section 'GM crops increase pesticide' of the Executive summary
14 Soybean acreage increased 5% from 2005 to 2006, explaining only a small portion of this increase.
15 Monsanto, 13 September 2005
16 In 2007, Monsanto recommended that farmers use tillage and apply a pre-emergence herbicide in combination with Roundup to kill resistant weeds (Henderson & Wenzel 2007)
17 Benbrook, 2005; Lapolla, 2007
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28 The Guardian, 21 April 2008. Food crisis threatens security, says UN chief
29 http://www.isaaa.org/resources/publications/briefs/37/executivesummary/default.html
30 Monsanto is the world's number one seed firm, with 20% of 2006 global commercial seed sales (ETC, 2006). Its dominance is far greater (roughly 90%) in the market for "traits" incorporated in GM soybeans, corn and cotton. This is because Monsanto has numerous lucrative licensing arrangements with other seed firms (e.g. Bayer, DuPont-Pioneer, and many smaller companies) which deploy Monsanto's traits, such as Roundup Ready, in their own seed varieties.
31 The price of GM seeds is largely determined by the number of traits they contain, with triple-stack corn seed, for example, costing significantly more than corn with two traits, which is more costly than single-trait corn. GM seeds generally cost two to four times more than conventional seeds, which are becoming ever scarcer in the seed marketplace.
32 Goldman Sachs conservatively estimates that Monsanto's (vs. the retail) price for Roundup will increase by 38% from FY2007 ($13/gallon) to FY2008 ($18/gallon), and by 58% from FY2007 to FY2009 ($20.50/gallon), noting that "there could be some upside to our forecasts from Roundup inflation."
33 Increased Roundup sales are also being driven by dramatically increased application rates due to the rapid evolution of glyphosate-resistant weeds no longer killed with the normal dose of the herbicide.
34 Non-Roundup Ready GM corn seed incorporates one or both of two insect-resistance traits: one for certain above-ground pests and one to defend against corn rootworm, a root pest.
35 www.nationmaster.com/graph/agr_agr_lan_sq_km-agriculture-agricultural-land-sq-km
36 ISAAA, 2008. www.isaaa.org/resources/publications/briefs/37/pptslides/default.html
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40 Arable land includes land used for annual crops, such as soya and wheat. Not including permanent crops such as orchard and vineyards
41 http://www.gmfreeze.org/uploads/GM_crops_land_area_final.pdf
42 See Petition Nos. 04-264-01p, 04-362-01p, 06-178-01p and 06-234-01p
43 The USDA lists the dual herbicide-tolerant corn as tolerant to glyphosate and "imidazolinones" – imidazolinones are one class of the acetolactate synthase (ALS) inhibitor group of herbicides. DuPont-Pioneer refers to this dual herbicide-tolerance as "Optimum GAT" in both soybeans and corn.
44 As of August 23, 2007, 352 of 970 active permits (36.3%) involved an HT trait. Some permits involve multiple traits. (Information Systems for Biotechnology, 23 August 2007).
45 Roundup Ready soybeans, corn and cotton. We exclude Roundup Ready canola, which was planted on 0.5 million acres in 2006, because USDA has not reported the amount of glyphosate used on canola.
46 Soybean acreage increased 5% from 2005 to 2006, explaining only a small portion of this increase.
47 Based on Center for Food Safety's analysis of herbicide-resistant weed data downloaded from www.weedscience.com on Nov. 21, 2007.
48 Based on Center for Food Safety's analysis of herbicide-resistant weed data downloaded from www.weedscience.com on Nov. 21, 2007.
49 "Who Owns Nature? Corporate Power and the Final Frontier I the Commodification of Life" ETC Group 2008
50 "Who Owns Nature? Corporate Power and the Final Frontier I the Commodification of Life" ETC Group 2008
51 GM soy started to be grown in Argentina in 1996
52 http://www.foeeurope.org/GMOs/Who_Benefits/FULL_REPORT_FINAL_FEB08.pdf
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56 France banned MON810, Monsanto's pesticide promoting GM maize, the only crop to be authorized for cultivation in the EU. Previously Bt 176 was also authorised for cultivation in Europe but this has since been wirthdrawn by the producer company Syngenta following controversy around its use of an antiobiotic resistance marker gene
57 http://www.europeanvoice.com/article/2008/09/drop-in-genetically-modified-crops-grown-in-eu/62491.aspx
58 Sygenta's Bt 176 was also granted approval for commercial growing but this GMO is no longer marketed
59 Countries which have banned MON810 are Austria, France, Greece, Hungary and Poland
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62 ISAAA, 2008. www.isaaa.org/resources/publications/briefs/37/pptslides/default.html
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65 Main regions growing Bt maize are Aragon, Cataluna and Extremadura; followed by Navarra and Castilla.
66 Coexistence is a policy concept designed to define how GM crops can be grown alongside conventional and organic crops. Because of the risk of genetic contamination from GM crops this is a controversial issue
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75 Case of GM maize « Herculex » found to contaminate a maize shipment from the US at an EU port. At the time « Herculex » was not authorised in the EU and therefore level of contamination was illegal because of « zero tolerance » rules

Left: Food markets.
Right: Local women.

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