agriculture & food

GM cotton harvesting in the Makhatini Flats of South Africa.

issue 111

who benefits from gm crops?

an analysis of the global performance of gm crops (1996-2006)

january 2007

Friends of the Earth International

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Friends of the Earth International


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genetically modified crops fail to deliver benefits

Meena Raman, Friends of the Earth International Chair, Malaysia and Nnimmo Bassey, Friends of the Earth Nigeria

Agriculture is a crucial activity for humankind, and is vital for the production of the world's food, feed, and fiber. Although there is enough food in the world to feed all of the planet's inhabitants, more than 850 million people do not have enough to eat each day.

Most of these deprived people, constituting around 13% of the global population, live in Africa and Asia. Seventy percent of the world's hungry live in rural areas, where agriculture is the main activity for sustaining livelihoods. Over the last decades, the majority of the world's small-scale farmers have witnessed shrinking incomes and the erosion of their food sovereignty. There is a wide array of reasons for this grim situation, including depressed prices, lack of government support, insufficient credit, insecure land tenure and natural factors like drought and floods.

In the past decade, genetically modified (GM) crops have been promoted to farmers as an important tool for tackling hunger, poverty and malnutrition. GM crops have been touted as providing higher yields and better quality, and as reducing pesticide use. Billions of dollars have been invested in promoting GM crops as a 'magic bullet' to address the main challenges faced by farmers around the world.

Organizations funded by biotech corporations, including the International Service for the Acquisition of Agri-biotech Applications (ISAAA), have strongly advocated the commercialization of GM crops. The mainstream media has picked up their message that GM technology has provided huge benefits for millions of farmers, consumers, and the environment.

However, a thorough investigation undertaken by Friends of the Earth groups and our allies since 2005 has exposed a different reality. Our research has been based on existing publicly available information from industry, governments, intergovernmental agencies, academia and civil society, amongst others.

We have found that the GM crops commercialized in the last decade have failed to deliver the promised benefits. There is overwhelming evidence that GM crops have done nothing to tackle hunger, as they are predominantly grown to feed animals rather than humans. Furthermore, the livelihoods of the small-scale farmers who have planted GM crops have not substantially improved. GM crops have not reduced pesticide use, so the environment has also not benefited. GM crops are neither cheaper and nor better quality, so they have not provided advantages to consumers. In short, GM have not proven superior to existing conventional crops.

time to make the right investments in agriculture!

In a world in which millions of people do not have sufficient access to food, every dollar spent and invested in agriculture is crucial. The 2006 Food and Agriculture Organization report on global food security recognizes that there are more hungry people in developing countries today - 820 million - than there were in 1996. This is ten years down the road from the 1996 World Food Summit in Rome, which promised to reduce the number of undernourished people by half by 2015. Far from decreasing, the number of hungry people in the world is increasing at a rate of four million per year. Agricultural investments are crucial in changing this situation, and we cannot afford to misuse scarce financial resources in implementing 'false solutions'.

The challenges of hunger and poverty have well-known solutions, and can only be resolved through appropriate political will and sovereign actions. It is time for governments to undertake a comprehensive analysis of the performance of GM crops, and to invest in solutions that secure the food sovereignty of rural populations and the sustainability of our agriculture over the long term.

one introduction

introduction

1.1 the beginning

Genetic engineering is a radical new technology that allows scientists to manipulate the DNA of living organisms. The modification of plants began in laboratories in the 1980s, with grand promises that the results would feed the world and cure malnutrition. In 1994, the first genetically modified (GM) food was marketed in the United States. Two years later, over 1 million hectares of land around the world had been sown with GM seeds, the vast majority in the US.

Controversy still rages over the technology's benefits and risks and the way that genetically modified organisms (GMOs) have been introduced around the world. This report examines the experience of 12 years of commercialization of GM food and 10 years of extensive planting, and draws some preliminary conclusions about the GMO crop revolution.

1.2 geographic and corporate concentration

Currently, a limited number of large corporations dominate the market, producing a narrow range of GM crops that only a few countries cultivate. Four crops - soybeans, maize, cotton and canola - represent almost all of the world's GM crop acreage, and most are engineered for herbicide tolerance or insect resistance. Herbicide-tolerant crops can survive application of a powerful weed killer that would kill a non-engineered plant, making it easier for farmers to control weeds growing near the crop. Insect-resistant crops are engineered with an insecticidal protein from a soil bacterium, Bacillus thuringiensis (Bt), that makes the plant's leaves or grain deadly to certain pests.

In 2005, 71% of all GM-planted acreage was sown with herbicide-tolerant versions of the four crops: predominantly Monsanto's Roundup Ready brand, engineered for use with its Roundup (glyphosate) weed killer. Insect-resistant or 'Bt' strains of cotton and corn accounted for another 18%. The remaining 11%, meanwhile, contained engineered cotton and corn 'stacked' with both herbicide-tolerant and insect-resistant traits.

Only a handful of countries have commercialized GM crops to a significant extent. Between 1996 and 2002, over 90% of the cultivated global surface was in the US, Argentina and Canada.

Over 80 million hectares of GM crops are planted today in the world; however, they occupy just a small share of total global crop land, about 1.5%. Nonetheless, organizations such as the International Service for the Acquisition of Agri-biotech Applications (ISAAA, see box) report widespread adoption around the world.

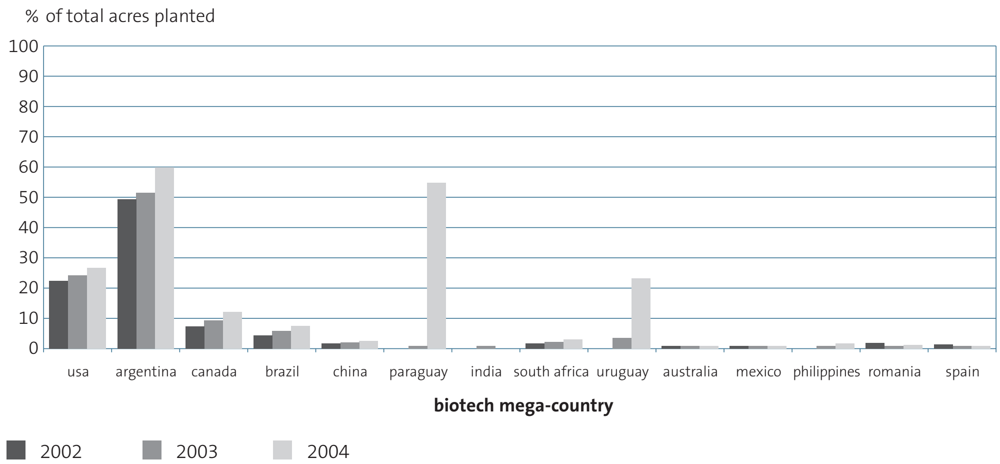
ISAAA ranks some 12 countries as "biotech mega-countries", each of which plant at least 50,000 hectares. Although the designation "mega" implies that these countries sow vast tracts of land with GM crops, in fact the 50,000 hectare threshold is so low that GM planting makes up less than 3% of the total agricultural crop land in most of the "mega-countries". Argentina, the US, Paraguay and Uruguay are the only countries in which the proportion of GM crops has risen above 20%, and the latter two countries "have such a small amount of farmland that penetration to 20% could happen in one year" (Polaris Institute, 2006). It is clear that even after a decade of cultivation, there is still no widespread worldwide adoption of GM crops.

what is isaaa?

ISAAA defines itself as "a not-for-profit organization that delivers the benefits of new agricultural biotechnologies to the poor in developing countries". However, its structure and the work it carries out show that ISAAA's agenda is set by transnational corporations that aim to legitimize and promote the introduction of GM crops around the world. ISAAA receives funds from all of the big biotech promoters, including agribiotech corporations like Monsanto and Syngenta.

The annual Global Review of Commercialized Transgenic Crops, conducted by ISAAA since 1996, is now internationally accepted as the authoritative reference for the global deployment of commercialized GM crops. These reviews have served as the basis for other highly publicized reports, such as the 2004 UN Food and Agriculture Organization report on GM crops and farmers (FAO, 2004). In general, governments and 'prestigious' institutions around the world refer to ISAAA data to support the global benefits of GM crops. ISAAA figures of global hectarage are officially legitimized by their inclusion on the website of the United States Department of Agriculture (USDA).

FIGURE 1 GM ACRES PLANTED TO TOTAL AGRICULTURAL ACRES



Source: *Polaris Institute, 2006.*

1.3 isaaa claims full-scale benefits from gm crops

In its 2005 report, ISAAA announced great progress in the introduction of GM crops, and portrayed farmers as the main beneficiaries. "The experience of the first nine years, 1996 to 2004, during which a cumulative total of over 385 million hectares of biotech crops were planted globally in 22 countries, has met the expectations of millions of large and small farmers in both industrial and developing countries," it said. According to ISAAA, consumers also reaped rewards from the new agricultural technology: "The continuing rapid adoption of biotech crops reflects the substantial improvements in productivity, the environment, economics, health and social benefits realized by both large and small farmers, consumers and society in both industrial and developing countries" (James, 2004).

However, criticism of ISAAA's analyses, methodology and data sources have been mounting in recent years. Many governments in developing countries do not keep track of or monitor the areas planted with GM crops, and it is therefore impossible to obtain official statistics for the first decade of cultivation from countries such as South Africa, the Philippines or Brazil. ISAAA acknowledged this problem in its 2006 report, admitting that it acquires most of its data from developing countries "through informal contacts" (James and Krattiger, 1996). Nevertheless, ISAAA reports contain figures relating to GM crop acreage that are often taken as official and quoted by other sources.

In describing the Philippines, for example, ISAAA claimed that more than 50,000 hectares were cultivated with GM corn. When ISAAA director Dr. Randy Hautea was asked about the source of these statistics, he replied that they came from the Department of Agriculture in the Philippines. However, the Philippine government does not monitor the areas planted with GM corn, nor does it have a system to track the quantities of seeds sold to farmers. The Philippine Bureau of Agricultural Statistics had no figures on the hectarage or number of farmers using GM corn, and an official from the government said that the ISAAA claim was superfluous (personal communication, 2005b). ISAAA has a history of inflating figures, even in countries where there is official data. For example, the US estimates compiled by Huib de Vriend of LIS Consult show an average of between 2 and 9% inflation of USDA data in ISAAA figures.

one introduction

TABLE 1 ESTIMATES OF ACREAGE CULTIVATED WITH GM CROPS IN THE USA, 2000 – 2004

YEAR	USDA (1,000 HA)	ISAAA (1,000 HA)	ISAAA – USDA (1,000 HA)	ISAAA – USDA % OVERESTIMATED
2000	28,157	30,300	2,143	7.6%
2001	32,751	35,700	2,949	9.0%
2002	36,948	39,000	2,052	5.6%
2003	40,781	42,800	2,019	4.9%
2004	45,367	47,600	2,233	4.9%

Sources; *LIS Consult, 31 May 2005. Based on NASS – USDA, Prospective Plantings 2000 – 2004 and ISAAA, Global Review of Commercialized Transgenic Crops 2000 – 2004.*

Figures can also vary from year to year in ISAAA reports with no justification provided. The 2004 ISAAA report, for example, stated that 7 million resource-poor farmers in cotton-growing provinces of China benefit from GM crops (James, 2004). In the 2005 document, however, the number of Chinese farmers benefiting from the technology had fallen to 6.4 million with no explanation (James, 2005). Meanwhile, Indonesia was ranked as the 19th largest GM producer in the organization's 2003 report, but inexplicably disappeared from the map in 2004. Details such as these reveal a lack of rigour in handling and describing figures.

1.4 the benefits of gm crops: what is real and what is hype?

ISAAA paints a rosy picture of the advantages of GM crops, and does not describe a single significant problem related to their introduction in any country around the world. Are analyses by organizations such as ISAAA correct? Are the benefits of GM crops as positive as the pro-biotech interests claim? If GM crops are safe, economically profitable, and environmentally friendly, why has there been so much opposition, concern and controversy? If the scenario is so good, if so many millions of farmers and consumers are benefiting, if the increase in harvest is so impressive, and if poverty, malnutrition and hunger have been alleviated in developing countries, why then have some governments imposed bans and moratoriums? Why do consumers oppose those products in many places around the world?

A hard look at the facts reveals strong opposition to GM crops, as well as numerous problems and unfulfilled claims. Since 2005, Friends of the Earth groups and their allies around the world have been engaged in a thorough evaluation of the performance and impacts of GM crops, with the goal of weeding out the hype in order to provide a more accurate picture of the reality. This report intends to help answer two critical questions: What benefits have GM crops brought to the world? And for whom?

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two the introduction of genetically modified crops in the united states

the introduction of genetically modified crops in the united states

Bill Freese, Center for Food Safety, United States
and Juan López Villar, Friends of the Earth International

1. introduction

Biotechnology proponents in the United States claim that GM crops are good for consumers, farmers and the environment, and that they are growing in popularity around the world. Such claims are seldom subjected to critical scrutiny, however, though they are often repeated as fact by the media. A close look at the US experience shows that the actual situation is a good deal more complex. This chapter aims to provide a nuanced, fact-based assessment of GM crops in the country where they have been most widely adopted - the United States.

2. the us agriculture system and big agribusiness

2.1 key crops in us farm fields

Corn, soybeans, wheat and cotton were the top four crops in terms of farm value in the United States in 2005. Corn production in 2005/06 was estimated at over 280 million tonnes, followed by soybean at 83 million, wheat at 57 million, and cotton at five million.

TABLE 1 PRODUCTION OF SOYBEAN, CORN, WHEAT AND COTTON IN 2005/06 IN THE UNITED STATES

CROP	(IN THOUSAND METRIC TONS)
1. Corn	282,260
2. Soybean	83,368
3. Wheat	57,280
4. Cotton	5,201

Source: *Based on USDA data, 2006k, 2006g, 2006l.*

Although these crops are used primarily in the domestic market, a large portion is also exported, providing an important source of revenue for the US economy. In 2006, agricultural exports totaled a record of $68.7 billion, an increase of $6.2 billion from 2005 (USDA/ERS, 2006d).

As we can see in table 2, significant percentages of the total production are devoted to exports in the four main crops. Cotton is the only one of the four crops for which exports exceed domestic consumption. In 2005, over 75% of the cotton produced in the US was exported, followed by 47% of the wheat, 40% of the soy and 19% of the corn.

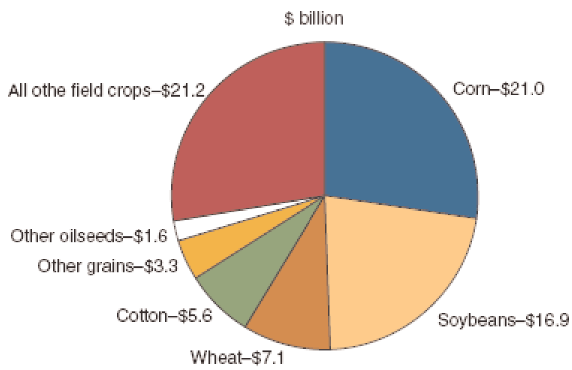
TABLE 2 COMPARISON BETWEEN WORLD AND UNITED STATES PRODUCTION AND EXPORTS OF SOYBEANS, CORN, COTTON, AND WHEAT IN 2005

(IN THOUSAND METRIC TONNES)

CROP	WORLD PRODUCTION	WORLD EXPORTS	UNITED STATES PRODUCTION	US EXPORTS
Soybean	258,537	132,271	83,368	33,443
Corn	693,290	82,714	282,260	56,200
Cotton	24,852	9,876	5,201	3,927
Wheat	618,921	113,671	57,280	27,424

Source: *Based on USDA data, 2006k, 2006g, 2006l.*

FIGURE 1 US CROPS IN FARM VALUE, 2005



Source: *USDA/ERS, 2006b.*

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2.2 corn

Corn is the lead crop in the United States, claiming around 16% of total land devoted to agricultural production. Half of the available US production of corn goes into livestock feed, whereas 17% of the available US corn output is used for seed, food products (starches, sweeteners, oil, alcohol for beverages), and industrial products (alcohol and fuel ethanol) (Foreman, 2006).

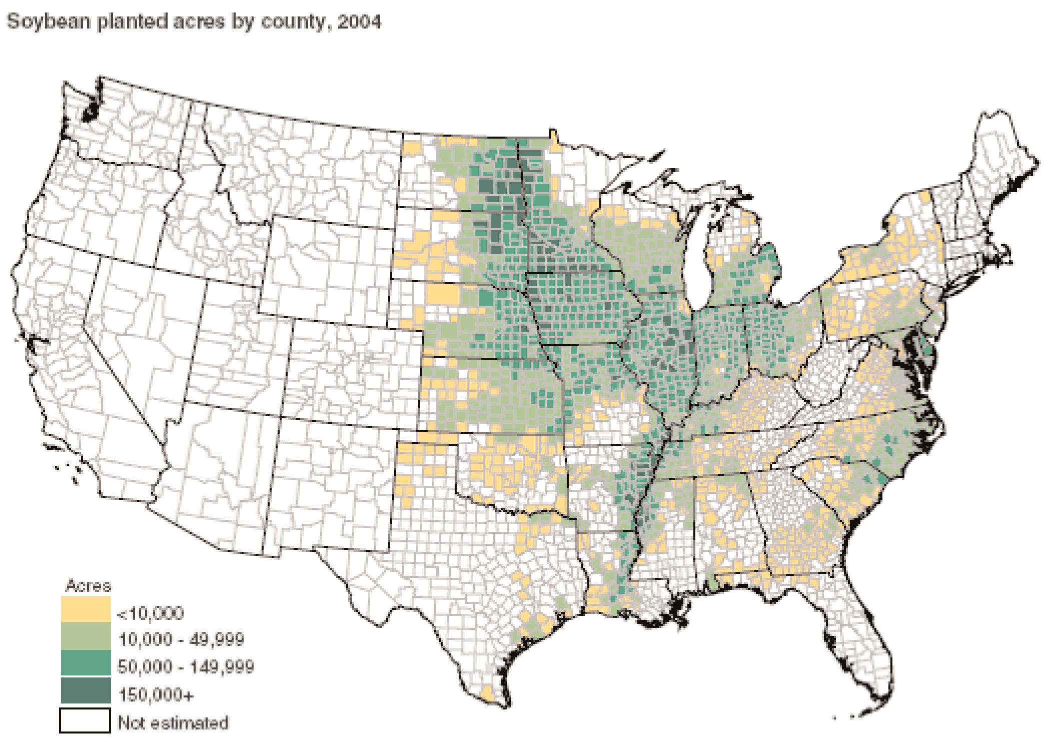
2.3 soy

Soy is the main oilseed produced in the US, accounting for about 90% of all oilseed production. Most of the soybeans are planted in the upper Midwest, the Delta and the Southeast.

Total US soy production in 2005 was valued at close to $17 billion. Almost all soybeans are crushed domestically - a process that separates and extracts the oil and high protein meal - or dedicated to export. A small amount of whole soybeans are used for seed or used on-farm as dairy feed. Distinct varieties of 'food-grade' soybeans are processed by wet-milling to produce tofu, soymilk, veggie burgers, miso, natto, tempeh and similar protein-based food products.

Soymeal is the most valuable end product, and is by far the world's most important protein feed, making up almost 65% of world protein feed supplies. In the US, livestock feeds represent 98% of US soybean meal consumption, and only 2% is devoted to human foods such as bakery ingredients and meat substitutes.

FIGURE 2 **SOYBEAN PLANTED ACRES BY COUNTY, 2004**



Source: *www.ers.usda.gov/data/baseacres/*

Soybean oil represents around two thirds of total US consumption of vegetable oil, despite the fact that the oil yield of soybean is lower than that of other oilseeds such as sunflower and canola. This oil is mainly used in cooking oil, bakery shortening, frying fat, margarine, salad and other industrial applications.

According to the US Department of Agriculture (USDA), the future expansion of this crop seems limited due to competition from other crops and "possible constraints on yield growth" (USDA/ERS, 2006b).

2.4 cotton

US cotton is a heavily exported commodity (USDA/ERS, 2001b). The cotton model of production is largely based on intensive farming, with farm sizes varying from an average of 800 hectares in Texas to 200 hectares in the Carolinas and Mississippi. Cotton farming is highly subsidized, with more than $18 billion received from 1999 to 2005 (see chapter 4).

2.5 wheat

Wheat is one of the most important human food grains produced in the United States. There are five major classes of wheat in the US: hard red winter, hard red spring, soft red winter, white and durum, with different end uses and production focused in specific regions (see chapter 6, New Crop and the Contamination Paradigm.)

2.6 concentrated seed market

Until the 1930s, commercial seed in the United States was supplied mainly by small, family-owned businesses, and these businesses were almost exclusively dependent on plant breeding research in the public sector. More than three-quarters of all rural counties depended on agriculture as their primary source of income, and there were 30.4 million people living and working on 6.3 million farms. The rural farm population represented over half of the total rural population, which itself was a quarter of the US total. By the turn of the 21st century, however, the farm population had declined dramatically. Today, 5.9 million people live or work on 2.1 million farms, representing just 2% of the total US population. Due to low commodity prices, many of these remaining farmers and their family members must take off-farm jobs in order to survive. These facts help to explain why only 20% of rural US counties now depend on agriculture for more than 15% of their earnings (Offutt, S. and Gundersen, C., 2005).

Towards the end of the 20th century, the seed industry became highly concentrated, and it is now characterized by oligopolistic competition between a few large corporations. For instance, three companies - Pioneer, Monsanto and Novartis - accounted for nearly 70% of US corn seed sales in 1997, and two - Monsanto and Delta & Pine Land - sold more than 80% of the cotton seed varieties planted that same year (Fernandez-Cornejo, J., 2004). The concentration in the cotton sector will further increase if Monsanto acquires Delta and Pine Land Company (see chapter 4).

3. the adoption of gm crops in the us

It is no coincidence that the introduction of GM traits for commercial purposes has taken place in the key strategic crops for United States agribusiness. Genetically modified varieties of three of the top four crops - soy, corn and cotton - have became widely commercialized in the last decade in North America. However, the genetically modified variety of wheat Monsanto was planning to introduce in 2004 failed to reach commercialization.

The first significant commercial planting of GM crops in the US took place in 1996. In the decade since then, adoption has increased substantially, and US farmers are now growing tens of millions of hectares of biotech crops. Yet what often goes unmentioned is that very few GM varieties are being grown commercially. As of November 2006, the USDA had approved 70 distinct biotech 'events' for commercial use. These 70 varieties are combinations of 14 different crops and 10 different traits or trait combinations.

Despite the diversity of GM crops that could be planted, since the 1990s only four crops with two traits have been grown to any significant extent (see table 3). These four crops are soybean, corn, canola and cotton. The two traits are herbicide tolerance (HT) and insect resistance (IR). HT crops are engineered to withstand direct spraying with weed killers, while IR crops generate insecticides in grain and other plant tissues. Various combinations of these four crops and two traits account for virtually 100% of biotech acreage, both in the US and elsewhere.

two the introduction of genetically modified crops in the united states

TABLE 3 **GM CROPS APPROVED FOR COMMERCIAL PRODUCTION (+ BOXES) VERSUS THOSE ACTUALLY GROWN FOR COMMERCIAL USE (SHADED + BOXES)**

CROP	HT	IR	HT / IR	STERILE POLLEN	HT / STERILE POLLEN	VR	IR / VR	DELAYED RIPENING	ALTERED COMPOSITION	LOW NICOTINE
ALFALFA	+									
BEET	+									
CANOLA	+				+				+	
CHICORY				+						
CORN	+	+	+	+	+					
COTTON	+	+	+							
FLAX	+									
PAPAYA						+				
POTATO		+					+			
RICE	+									
SOYBEAN	+								+	
SQUASH						+				
TOBACCO										+
TOMATO		+						+		
TOTAL	8	4	2	2	2	2	1	1	2	1

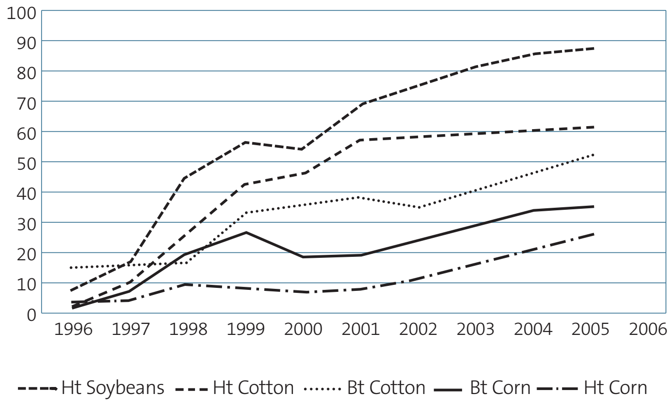
This table portrays the universe of genetically engineered (GE) crops that have been deregulated (i.e. approved for commercial cultivation and sale) by the US Department of Agriculture as of November 17, 2006, and the subset of these approved GE crops that are actually being grown to any significant extent for commercial use in food products. GE crops are broken down by trait or trait combination (see Legend below). Tinted boxes represent the GE crop types that comprise virtually 100% of those that are commercially grown and in the food supply. An empty box signifies that there are no approved versions of the pertinent crop-trait combination.

Legend: *HT = herbicide-tolerant; IR = insect-resistant; VR = virus-resistant; HT/IR, HT/Sterile pollen & IR/VR = 'stacked' crops with both of the indicated traits. Sterile pollen corn is used for breeding purposes. Altered composition indicates altered oil composition (soybeans and canola) or altered protein composition (corn). Note that "+" boxes in some cases represent several GE crop 'events' - or differing versions of the same basic crop-trait combination - approved in the pertinent category. Based on USDA data, current as of December 5, 2006, from www.aphis.usda.gov/brs/not_reg.html.*

While as indicated above the adoption of biotech crops is narrow in its limitation to just a few plants and traits, it is widespread. In terms of total US hectarage, soybeans genetically modified to survive the application of specific herbicides have been the most popular GM crop, followed by biotech corn, cotton and canola (see figure 3) (USDA/ERS, 2006a).

It should be noted that of the three biotech food crops, the two that are most widely planted, soybeans and corn, are used primarily for animal feed and industrial applications rather than as human food. As we will see, biotech crops intended wholly or primarily for human consumption have been rejected in the marketplace.

FIGURE 3 **ADOPTION OF GENETICALLY ENGINEERED CROPS IN THE US 1996-2006**



Data for each crop category include varieties with both HT and BT (stacked) traits.
***Source:** USDA/ERS, 2006a.*

3.1 monsanto

One company, Monsanto, has spearheaded the development of the new technologies that have led to the widespread commercialization of four GM crops in North America. Monsanto estimates that 90% of all commercialized GM varieties in the world have the company's traits.

The Monsanto Chemical Company was founded in 1901, and is headquartered just outside St. Louis, Missouri (Tokar, B., 1998). For many decades, Monsanto was known as a maker of chemicals for industry (such as PCBs), the military (such as Agent Orange), food companies (such as the artificial sweetener aspartame) and agriculture (such as weedkillers).

Monsanto's transformation into a biotechnology company began in the 1980s and 1990s with the acquisition of seed companies, including some of the nation's largest, such as DeKalb, Agracetus, Asgrow Agronomics, Holden Foundation Seeds and Calgene, to name just a few (Fernandez-Cornejo, J., 2004). The latest major acquisition, in 2005, was Seminis, the world's largest vegetable seed company (Monsanto, 2005d). With Seminis, Monsanto surpassed Pioneer Hi-Bred (itself taken over by DuPont) to become the world's largest seed company (ETC, 2005). Monsanto is currently in the process of acquiring Delta & Pine, and if this succeeds, the concentration of cottonseed in Monsanto's hands will be increased (see chapter xx).

In addition, Monsanto has acquired significant patent rights over a multitude of genetic engineering techniques and genetically engineered seed varieties, and requires farmers purchasing its seed to sign an agreement that prohibits the saving of the seed. In this context, Monsanto has acquired an unprecedented level of control over the use and sale of seed in the United States.

In 2004, more than 175 million acres of GM crops were planted by farmers, 90% of them using Monsanto's technology (Monsanto, 2004a). Monsanto accounted for 91% of the global area covered with GM soybeans in 2004 (of the 119.5 million total acres, 109 million were Monsanto). It accounted for 97% of GM maize, 63.5% of GM cotton, and 59% of GM canola in 2004 (ETC, 2005). Roundup Ready soybeans accounted for more than 80% of all soybeans planted in the United States. In addition, Monsanto's Roundup is the world's top selling herbicide (Monsanto, 2004a).

From the very beginning, Monsanto's top priority has been to genetically engineer its seeds to foster increased use of the company's Roundup. This allows Monsanto to profit twice: from an added 'technology fee' for the seed, and from increased sales of the Roundup that is used with the seed. According to the New York Times, "Monsanto has maintained and even souped up Roundup's status by forging what analysts say was a brilliant strategy of dropping its price years ahead of patent expiration and tying its use to the early growth of genetically modified crops - crops made to work in tandem with the herbicide." (The New York Times, 2001b).

Monsanto has engineered the herbicide-tolerant trait into widely-grown crops like soybeans, corn, cotton and canola in order to maximize profits. The company's bid to introduce a herbicide-tolerant version of wheat, the world's most widely grown crop, was thus not unexpected. However, Monsanto dropped its Roundup Ready wheat project in 2003 due to strong resistance from wheat growers in the US and Canada and wheat importers in Europe and Asia.

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TABLE 4 **WORLD'S TOP 10 SEED COMPANIES + 1**

COMPANY	2004 SEED SALES (US MILLIONS)
1. Monsanto (US) + Seminis	$2,277 + $526
(acquired by Monsanto in March 2005)	pro forma = $2,803
2. DuPont/Pioneer (US)	$2,600
3. Syngenta (Switzerland)	$1,239
4. Group Limagrain (France)	$1,044
5. KWS AG (Germany)	$622
6. Land O'Lakes (US)	$538
7. Sakata (Japan)	$416
8. Bayer Crop Science (Germany)	$387
9. Taikii (Japan)	$366
10. DLF-Trifolium (Denmark)	$320
11. Delta & Pine Land (US)	$315

Source: *ETC Group, 2005.*

3.2 corporate influence in designing a favorable regulatory and policy regime

The rapid pace of adoption of GM crops in the United States was supported by a very favorable regulatory and policy regime, shaped by the same companies that were pressing for the commercialization of GM crops. Indeed, big agribusinesses like Monsanto were the main designers of US biotech policy.

The influence of the biotech industry upon the regulatory system has been astonishing. Dr. Henry Miller, responsible for biotech issues at the US Food and Drug Administration from 1979 to 1994, declared that "in this area, the US government agencies have done exactly what big agribusiness has asked them to do and told them to do". A New York Times investigative article on the influence of Monsanto upon the US regulatory system concludes with the following self-explanatory statement: "What Monsanto wished for from Washington, Monsanto - and, by extension, the biotechnology industry - got. If the company's strategy demanded regulations, rules favored by the industry were adopted. And when the company abruptly decided that it needed to throw off the regulations and speed its foods to market, the White House quickly ushered through an unusually generous policy of self-policing." (The New York Times, 2001a).

Indeed, the biotech industry lobbied intensively for the most favorable framework for the commercialization of GM crops, with as few mandatory requirements as possible. US policy was based on the dubious concept of 'substantial equivalence', according to which GM crops should not be considered different from their conventional counterparts. Monsanto consistently opposed new laws designed specifically for GMOs, and pushed for a legal framework based on existing laws that had been formulated to regulate food additives, pesticides and plant pests (Freese & Schubert, 2004). The general assumption of substantial equivalence in the US is one of the key elements at the heart of many international conflicts today.

The US and its biotech industry have opposed the creation of specific regulations for GMOs not only domestically, but also at the international level. For example, they adamantly opposed the creation of the UN Biosafety Protocol, the first international agreement to regulate the transboundary movements of GMOs. When the Protocol received widespread international support, the US tried to subvert it and transform the negotiation process into a trade dispute (Chakravarthi Raghavan, 1995).

Over the last 18 years, the USDA has received and approved thousands of applications to field test GMOs, and few if any of the applications have been turned down due to concerns about risks. In the meantime, Monsanto has aggressively challenged any claims of risks or agronomic problems connected with its GM crops. If Monsanto has become aware of research that poses questions about the technology, it has challenged the findings and sought to discourage their publication or presentation at public meetings (Benbrook, 2000 & 2002). In one case, the company even refused to release the full version of a rat-feeding study that showed suggestive evidence of harm on the grounds that it was "confidential business information". The full study became available only after a German court ordered Monsanto to release it (Greenpeace, 2005a).

Monsanto funds significant agricultural research, and has threatened to withdraw this funding in order to deter criticism of its products. For example, the state of North Dakota was considering a bill imposing a moratorium on the development

of Roundup Ready wheat in 2001, but after Monsanto publicly threatened to pull back all of its agricultural research funding to the state's land-grant university, the legislature suspended discussion of the bill (Benbrook, 2002).

This capacity to influence regulations and policy is bolstered by a well-documented 'revolving door' between Monsanto employees and officials from US government agencies. For example, prior to his former posts as Secretary of the US Department of Commerce and US Trade Representative, Michael (Mickey) Kantor was a member of Monsanto's Board of Directors. Michael Taylor, who had previously worked as an attorney for Monsanto, was deputy commissioner of the US Food and Drug Administration when it controversially approved Monsanto's genetically engineered bovine growth hormone (rBGH), which increases cows' milk production while impairing their health. Taylor, who played a key role in the approval of rBGH, later returned to Monsanto as a vice president.

These connections are not limited to the US administration: Monsanto's former chief counsel, Rufus Yerxa, was appointed deputy to the WTO director general in August 2002. The Financial Times described Yerxa as "just the man [the WTO director general] will need should the US ever bleat to the WTO about EU restrictions on genetically modified food" (Financial Times, 2002).

Monsanto and the rest of the US agribusiness lobby have made a concerted effort to ensure that the government protects corporate interests. The ties between agribusiness corporations like Monsanto and the government are the result of strategically spent money: in 2000, the company dished out $2,002,000 on lobbying and donated lavishly to well-placed politicians. This generosity appears to have paid off with direct access for Monsanto to US government officials and negotiators, as well as representation on the government's Agricultural Policy Advisory Committee for Trade and the US Food and Drug Administration's Biotech Advisory Panel.

Monsanto is active in all of the major US agribusiness and biotech lobbies, including the Biotechnology Industry Organization (BIO), the US Grains Council, and the Food Industry Codex Coalition. It has a close and powerful ally in the American Farm Bureau Federation (AFBF), ranked by Fortune magazine as one of the most powerful organizations in Washington. Despite its cultivated appearance as a "grassroots farmers' organization", the AFBF has extensive corporate connections and its policy positions reflect the concerns of corporate agribusiness. The AFBF totally supports GM crops, including bio-pharmaceutical and industrial types, and has opposed US endorsement of the Biosafety Protocol (American Farm Bureau Federation, 2005).

Monsanto also has an influence on charities and foundations. The best example of this is provided by the recent hiring of Rob Horsch, Monsanto's vice president, by the Gates Foundation based in the United States. Horsch is the scientist who headed the GE seeds section at Monsanto. His new tasks are reportedly "to apply the technology toward improving crop yields in regions including sub-Saharan Africa, where the foundation recently launched a major drive with the Rockefeller Foundation". (Seattle Times, 2006). Horsch's record on GM crops in Africa is at the very least disappointing, since he and other colleagues at USAID conceived the failed GM sweet potato project in Kenya (see chapter 6 on New Crops and the Contamination Paradigm).

3.3 an assault on north american farmers

Monsanto's aggressive promotion of its biotechnology products, such as recombinant bovine growth hormone (rBGH), has been widely documented and includes a history of ethically questionable practices (Tokar, B., 1998). With GM crops, Monsanto is extending such practices and threatening the livelihoods of farmers worldwide. The decade-long experience of North American farmers with GM crops is full of striking examples of these practices, and the threats that big corporations like Monsanto pose to world agriculture.

Monsanto's seed policy is characterized not only by the aggressive patenting of the techniques needed to create a GM crop, but also the patenting of the seeds and plants themselves.

Monsanto has over 600 such patents, more than any other biotech company (Center for Food Safety, 2005). Today, the company is harassing and suing farmers for doing what they have been doing for centuries: saving seeds. Today, North American farmers who purchase patented seeds are prevented from freely saving them to use the following season. In fact, Monsanto requires farmers in the US and other countries who use seed containing their patented technology to sign a technology agreement that commits them to buying fresh seed every season (Moeller and Sligh, 2004).

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By signing the technology agreement, the grower agrees to the following: "Not to supply any seed containing patented Monsanto technologies to any other person or entity for planting. Not to save any crop produced from seed for planting and not to supply seed produced from seed to anyone for planting. Not to use or to allow others to use seed containing patented Monsanto Technologies for crop breeding, research, generation of herbicide registration data, or seed production." (Monsanto, 2005e).

One consequence of the concentration of the seed industry and Monsanto's seed policy is that US farmers now have fewer seed choices. According to the US-based Center for Food Safety, "for many farmers across the country, it has become difficult if not impossible to find high quality, conventional varieties of corn, soy, and cotton seed". (The Center for Food Safety, 2005).

This strongly suggests that Monsanto, through its numerous seed companies, is offering many of its best seed varieties only in GM versions. In other words, farmers must buy GM in order to get higher quality seeds, even if they do not want the GM trait. Thus, GM adoption rates may give an exaggerated impression of farmers' interest in GM crops.

This level of domination and control over US farmers has no precedent, and has had serious negative impacts on their livelihoods. Farmers who decided to replant Monsanto seeds have faced financial penalties, forcing some into bankruptcy. Even more worrisome are the cases of farmers who have never bought Monsanto seeds but who have been penalized when their fields have been contaminated with patented Monsanto varieties (Moeller and Sligh, 2004). Monsanto has been brutally enforcing the technology agreements with US farmers by building "a department of 75 employees and setting aside an annual budget of $10 million for the sole purpose of investigating and prosecuting farmers for patent infringement". (The Center for Food Safety, 2005). The Washington Post reported that "the company has hired full-time Pinkerton investigators and, north of the border, retired Canadian Mounted Police, to deal with the growing work load, a total now of more than 525 cases, about half of which have been settled". (Washington Post, 1999).

Thousands of US farmers have been investigated by Monsanto. In many cases, these intrusive investigations make "farmers feel like criminals even before accusations are made, as investigators frequently solicit local police officers to escort them onto farmers' properties". (Center for Food Safety, 2005). Many farmers settle with Monsanto, but others end up in court. Most farmers who land in court are confronted with a very unbalanced situation, as their financial and legal resources are invariably smaller than those of the multi-billion dollar company. In many cases, these farmers cannot afford any legal representation whatsoever and must stand alone in trial against Monsanto.

In 2003, Monsanto claimed to have opened 600 new cases of what it calls "seed piracy," and the company reported 500 cases in 2004. The final outcome of Monsanto's investigations and lawsuits against farmers often remain unknown because the company has insisted on the inclusion of a clause that prevents farmers from disclosing the terms of the settlement. But the cases for which information is publicly available reveal significant payments to Monsanto. The true costs may be even greater than the payments reflected in table 4, as these do not include the plaintiff's attorney fees, the costs of testing fields, experts, and so forth (The Center for Food Safety, 2005).

TABLE 5 TOP 10 CASES ARRANGED BY SIZE OF KNOWN JUDGEMENTS

CASE	AMOUNT IN US$	DATE
Anderson, No. 4:01:CV-01749	3,052,800.00	4.6.2003
Dawson, No. 98-CV-2004	2,586,325.00	19.12.2001
Ralph, No. 02-MC-26	2,410,206.00	29.07.2003
Roman, No. 1:03-CV-00068	1,250,000.00	17.08.2004
McAllister (S.B.D., Inc.), No. 02-CV-73	1,000,000.00	10.09.2001
Eaton, No. 00-CV-435	866,880.00	11.10.2001
Thomason, No. 97-CV-1454	447,797.05	20.08.2001
Etheridge, No. 00-CV-1592	377,978.15	4.06.2002
Morlan, No. 02-CV-77	353,773.00	3.03.2004
Gainey, No. 03-CV-99	338,137.00	23.02.2004

- The total of the recorded judgements granted to Monsanto for these lawsuits is US$15,253,602.82.
- For cases with recorded judgements, farmers have paid a mean of US$412,259.54.
- The median settlement is US$75,000.00 with a low of US$5,595.00 and a high of US$3,052,800.00.
***Source:** The Center for Food Safety.*

3.4 corporate profits and benefit claims

As we have seen, the first generation of GM crops comprises almost exclusively varieties that contain herbicide-tolerant and/or insect-resistant 'input' traits. Input traits are designed for farmers, not consumers. These applications have dominated because they were technically possible and offered a very good way for companies to maximize profits through intellectual property rights and increased herbicide sales. Roundup Ready soybeans have provided Monsanto with hundreds of millions of dollars in 'technology fees' linked to the purchase of seed (Benbrook, 2000) and hugely increased sales of Roundup. Since input traits are the key focus of the first decade of GM crops in the US, it is not surprising that providers of inputs like herbicides (usually the very same company selling the GM seed) are the primary beneficiaries (Duffy, 2002).

The clear focus on input traits and maximization of profit for the industry would not preclude, in the view of industry and the US government, that farmers and consumers have benefited from GM crops. The biotech industry claims that GM crops in the US have provided "significant yield increases, significant savings for growers and significant reductions in pesticide use" (Monsanto, 2003; Carpenter et al., 2001). But do these claims accurately reflect the reality in the field? Have GM crops in fact reduced pesticide use, increased yields, and provided economic benefits to farmers? Have consumers benefited from the GM crops commercialized in the last decade?

3.5 higher or lower yields?

A significant number of studies by independent scientists demonstrate that GM crop yields are lower than, or at best equivalent to, yields from non-GM varieties. Reduced yields have in particular been found with Roundup Ready (RR) soy. For example, in 1998 several universities carried out a study demonstrating that, on average, RR soy varieties were 4% lower in yield than conventional varieties (Oplinger et al., 1999). These results clearly refuted Monsanto's claim to the contrary (Gianessi, 2000). Even strong supporters of GM crops, like the academics Qaim and Zilberman, recognized in a 2003 report published in Science that "in the United States and Argentina, average yield effects [of GM crops] are negligible and in some cases even slightly negative". (Qaim and Zilberman, 2003).

The Food and Agriculture Organization's 2004 report on agricultural biotechnology also acknowledges that GM crops can have reduced yields (FAO, 2004). This is not surprising when one considers that first-generation genetic modifications address production conditions (insect and weed control), and are in no way intended to increase the intrinsic yield capacity of the plant. Yields of both GM and conventional varieties vary - sometimes greatly - depending on growing conditions, such as degree of infestation with insects or weeds, weather, region of production, etc. (European Commission, 2000).

The fact that GM crop yields are not greater than those of conventional crops is even recognized in an April 2006 USDA report that states that "currently available GM crops do not increase the yield potential of a hybrid variety. [...] In fact, yield may even decrease if the varieties used to carry the herbicide-tolerant or insect-resistant genes are not the highest yielding cultivars." (Fernandez-Cornejo, J. and Caswell, 2006).

Roundup Ready soybean systems do not protect against other pests and diseases that may affect soybeans, for example rust. According to USDA, the incidence of rust in the United States could become a serious factor affecting future yields. Soybean rust was discovered at the end of 2004 in Louisiana, and although it has not yet caused huge damage, "the random and opportunistic nature of soybean rust could threaten major US soybean production areas in any given year". (USDA/ERS, 2006b).

what is rust?

Rust is a wind-borne fungal disease that attacks many legumes and other plant species. If left untreated, the highly pathogenic disease can cause severe losses through rapid defoliation of a crop. A soybean variety resistant to soybean rust is not currently available, although an array of fungicides proved effective in reducing its damage in South America. The typically aggressive progression of soybean rust can require repeated (and costly) chemical applications. ***Source:*** *USDA/ERS, 2006b.*

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3.6 less or more pesticide use?

Monsanto asserts that reduced use of pesticides (i.e. herbicides, insecticides and fungicides) 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 soy has dramatically increased pesticide use, particularly since 1999. In his exhaustive analysis of USDA pesticide usage data, Dr. Charles Benbrook, a leading expert on GM crops, concludes that GM soy, corn, and cotton have led to a 122 million pound increase in pesticide use since 1996, with a huge increase on herbicide-tolerant (HT) crops and a modest decrease on Bt crops: "While Bt crops have reduced insecticide use by about 15.6 million pounds over this period, HT crops have increased herbicide use 138 million pounds."

Dr. Benbrook identifies three key factors responsible for this increase in pesticide use:

1. Increased applications of glyphosate (Roundup) due to "the emergence and spread of weeds resistant or less sensitive to glyphosate";

2. Increased planting of herbicide-tolerant varieties due to the "limited supplies of conventional crop seeds in a number of popular maturity groups"; and

3. Increased attractiveness of herbicide-tolerance systems like Roundup Ready thanks to "aggressive herbicide price cutting by companies seeking a larger share of the market". (Benbrook, 2004).

Until the widespread adoption of Roundup Ready crops, there were just two confirmed cases of glyphosate-resistant weeds. But by 2005, six different weeds had become resistant in many countries, not to mention a long and growing list of weeds that have developed a degree of tolerance sufficient to require applications of other, often more toxic, herbicides.

Of the 37 cases of new herbicide-resistant weeds identified in the last decade, 20 were found in the US, and out of that 20, 17 appeared in the period between 2001 and 2005. Glyphosate-resistant horseweed was first discovered in Delaware in RR soybean and cotton fields in 2000, just five years after RR soy was introduced. In the following four years, it spread to 12 states, contaminating 1.5 million acres in Tennessee, up to 100,000 acres in Missouri, and 10,000 acres in Arkansas. Common waterhemp has developed resistance to multiple herbicides, including glyphosate, on at least 1,000 acres in Missouri. This surprisingly steep increase in the number of glyphosate-resistant weeds is almost certainly due to the increased and more frequent use of Roundup associated with widespread introduction of RR soybeans, cotton and corn (Weed Science, 2006a,b,c,d; Wisconsin Crop Manager).

TABLE 6 WEED RESISTANCE TO GLYPHOSATE IN THE UNITED STATES

WEED	STATE
Amaranthus palmeri Palmer Amaranth	2005 - USA (Georgia)
Amaranthus rudis Common Waterhemp	2005 - USA (Missouri)
Ambrosia artemisiifolia Common Ragweed	2004 - USA (Arkansas) 2004 - USA (Missouri)
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) 2006 - USA (Nebraska)
Lolium multiflorum Italian Ryegrass	2004 - USA (Oregon)
Lolium rigidum Rigid Ryegrass	1998 - USA (California)

Source: *Based on Weed Science, 2006. http://www.weedscience.org/Summary/UspeciesMOA.asp?lstMOAID=12*

Argentina may offer a lesson to the world in this respect. Roundup Ready soybeans comprise 99% of Argentine soybean hectarage. Roundup use on soybeans alone in Argentina climbed from virtually zero in 1995/96 to 40 million kilograms in 2003/04. With this skyrocketing use of Roundup and Roundup Ready soy, it is perhaps not surprising that 11 glyphosate-tolerant weed species can be found in Argentina (Benbrook, 2004 and 2005).

3.7 good or bad for farmers?

Whether GM crops benefit farmers is a complex issue that is influenced by many factors, including the crop, the size of the farm, the severity of insect infestation, and the weather. Non-economic factors must also be considered. Several reports conclude that net returns for GM farmers are equivalent to, or even less than, those for conventional farmers. For example, the USDA found either no economic gain or an economic loss with some GM crops: "The adoption of herbicide-tolerant soybeans did not have a significant impact on net farm returns in either 1997 or 1998. [...] (A)doption of Bt corn had a negative impact on net returns among specialized corn farms" (Fernandez-Cornejo et al., 2002).

However, more consensus exists around the 'convenience effect' of some GM crops. In the case of Roundup Ready crops, for example, most reports agree that this system leads to reductions in farm labor and increased flexibility in the timing of herbicide applications. These two benefits facilitate the ongoing consolidation of farmland in the hands of fewer and fewer corporate farmers, who are always seeking technological means of reducing their labor requirements. This may help to explain why a University of Wisconsin study found that a higher proportion of larger growers versus small farmers were adopting GM crops in the state (University of Wisconsin at Madison, 2000). The high (99%) adoption rate of Roundup Ready soy in Argentina, which is home to some of the world's largest soybean plantations and where only a small percentage of the population is engaged in agriculture, provides additional support for this thesis (Benbrook, 2005).

Flexibility and reduced labor expenditures for larger growers, however, does not always translate into higher economic returns. For instance, Mike Duffy, an Iowa State University economist, affirms that farmers' benefits from GM crops "appear to be more related to greater ease of production and the ability to cover more acres as opposed to an increase in the profits per acre" (Duffy, 2001).

In addition, with the growing problem of Roundup-resistant weeds, the 'convenience' effect of the Roundup Ready system is beginning to disappear, and as more pesticide applications are necessitated the costs may increase.

3.8 the failure of genetically modified papaya in hawaii

Genetically modified papaya was introduced in Hawaii in 1998. It was developed by the University of Hawaii's Manoa College of Tropical Agriculture and Human Resources in cooperation with other organizations and the private sector. The dean of the Manoa College claimed that if the GM papaya had not been introduced "there would be no papaya industry on the big Island" (Hashimoto, 2004).

However, the economic reality is quite different from this propaganda. In fact, the GM papaya has been a commercial failure: since its introduction in 1998, the total area of papayas harvested has declined by 28%, to less than 600 hectares. The selling price of GM papaya fell to 30-40% below production costs, and the price that farmers get today for the GM papaya is 600% lower than the price they receive for an organic papaya. These steep declines in hectarage and price are largely attributable to the rejection of GM papaya by Hawaii's key export markets, especially Japan (Greenpeace, 2006). In addition, GM papaya has created problems for the organic papaya industry due to uncontrolled contamination (ENS, 2004).

"Plenty of people are not growing papaya anymore. [...] The price is going down and still the costs of farming go up."

Alberto Belmes, Hawaiian papaya farmer, in the Honolulu Advertiser, 2006.

facts and realities about gm papaya in hawaii

"Hawaii papaya production sank to a more than 25-year low last year despite record demand among US consumers for the tropical fruit. Americans on average now eat one pound of papaya annually, which is up from less than one-third of a pound just 10 years ago. That should bode well for growers of Hawai'i's second largest fruit crop. However, last year papaya production fell 17 percent to 28.5 million pounds, the smallest crop since before 1980. Sales dipped 14 percent to $10.6 million, the lowest amount since 1985." ***Source:*** *The Honolulu Advertiser, 2006.*

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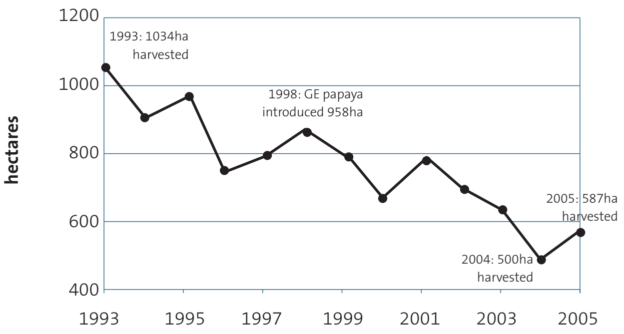
FIGURE 4 **PAPAYA PRODUCTION IN DECLINE, 2000-2005**

FIGURE 5 **HAWAIIAN PAPAYA FARMS IN DECLINE**



Source: *Greenpeace, 2006.*

3.9 benefits for whom?

"Use of herbicide-tolerant varieties results in lower herbicide and weed management costs. However, they also have higher seed costs and slightly lower yields.

If the returns to the herbicide-tolerant and non-tolerant varieties are similar, why have the tolerant crops been adopted so readily? The acreage planted of herbicide-tolerant varieties has gone from nothing a few years ago to more than half of the total acres planted, or higher depending on the estimate. There are several reasons for this phenomenon. First, the ease of harvest is an overriding consideration for many producers. An easy and fast harvest makes farmers more willing to adopt a new technology even if it does not produce clearly superior returns.

Farmers also may be using the herbicide-tolerant varieties on fields with particularly heavy weed problems. If the average returns are comparable, it is simpler to use the same varieties so that commingled soybeans are not an issue. Advertising and landlord pressure could also be part of the explanation for the phenomenal rise in the use of herbicide tolerant soybeans. Some landlords insist on clean fields, and the herbicide-tolerant varieties offer that option. But, given analyses in 1998 and again in 2000, there does not appear to be any difference in the per acre profitability between the two varieties. [...]

The preceding analysis shows that the primary beneficiaries of the first generation biotechnology products are most likely the seed companies that created the products. Additionally, in the case of herbicide tolerance, the companies that supply the tolerant herbicides also benefit from the development of the biotech crops.

It also appears that some farmers have benefited from biotechnology. Their gains, however, appear to more related to greater ease of production and the ability to cover more acres as opposed to an increase in the profits per acre. Farmers' benefits are evidenced by the rapid adoption of this new technology. As noted, in Iowa, soybean acres planted with herbicide-tolerant varieties went from zero to more than half the total acreage in just a few years. Farmers definitely perceive a benefit even if their profits are not increasing.

It has been argued that consumers are also the beneficiaries of the first generation biotech products because the increased production leads to lower prices. Whether or not production increases depends upon the crop under consideration. For soybeans, the yields actually are slightly less, while for corn they are slightly higher.

Regardless of the crop under consideration, it is hard to determine whether consumers actually benefit from the first generation biotech products. The prices for the basic commodities covered are already low due to abundant supplies. In addition, government programs that support prices will cost the taxpayers more if the prices continue to drop.

Consumers actually spend only a fraction of their food dollar on these basic commodities. Changes in the price of the basic commodities will have little impact on the prices charged to the consumers. Additionally, a consumer backlash against biotech indicates that, for at least some consumers, the addition of biotech crops is not seen as a benefit but an added risk.

Today's biotech crops and applications are merely the first generation of products. It appears from these examples that the primary beneficiaries are the seed and chemical companies and, to a lesser extent, the farmers. What will happen with the proposed second-generation products remains to be seen. [...]

Biotechnology is an extremely powerful tool. It has the potential to create many useful products as well as many unforeseen problems. As with any new technology, it must be evaluated carefully. It is not prudent to expect private companies to develop products for the public good. Companies are in the business of making money and the products they pursue are designed for that end. To expect any other result from private research is not appropriate or realistic."
Source: *Duffy, M., 2001. Who Benefits from Biotechnology?*

3.10 signs of weakness

Despite the power of the biotech industry, there are clear and growing signs of weakness. First, biotech companies have completely failed to introduce the long-promised consumer 'output' traits, such as enhanced nutrition. A look at table 3

shows that none of the approved GM crops involves a trait that benefits consumers. For instance, 'delayed ripening' tomatoes were engineered for longer shelf life (a benefit to industry), and flopped in the marketplace because they were tasteless. GM soybeans with altered oil content are grown on a very small scale (several thousand acres) for industrial use (ABIL, 2001).

Laurate canola - engineered to have high levels of the unhealthy saturated fat lauric acid for confectionary use - is not used in food due to "undesirable compositional qualities" (GEO-PIE). Monsanto's high-lysine corn is intended exclusively for animal feed. The only possible exception is a dubious one: 'low-nicotine' tobacco, a non-food crop. One reason for this failure is the technical difficulties involved in developing traits such as enhanced nutrition without unwanted side effects.

Another weakness is that the biotech industry appears to be running out of new ideas. Firstly, the number of permits granted for field trials of GM crops in the US climbed steadily from 1987 to peak in 2002, with a modest drop since then. Secondly, the biotech industry continues to focus its development efforts on the same traits, crops and applications that it did in the 1990s. Herbicide tolerance is still among the leading traits being field tested; corn and soybeans are still by far the most prevalent GM crops in field trials; and animal feed is the exclusive or primary intended use of most next-generation GM crops as well as for those that have already been commercialized (ISB, 2006).

Finally, it is becoming increasingly evident that modern conventional breeding, which can be accelerated through our growing knowledge of plant genomes, with for example 'marker-assisted breeding', is better suited to deliver many of the new traits that we have been told are only possible through genetic modification. Even industry leader Monsanto has turned to modern, non-GM techniques for several of its new products: the company's VISTIVE soybeans are conventionally bred to have lower levels of linolenic acid, which means lower levels of transfats in products containing processed soybean oil (Thatcher, 2004). In 2007, Monsanto and Solae intend to introduce a new line of soy proteins derived from soybeans conventionally bred to contain higher levels of beta-conglycinin, a naturally occurring protein said to improve the texture and flavor of soy protein products (Food Navigator, 2005).

Interestingly, Monsanto and other companies have tried - but failed - to develop and introduce crops with just these sorts of nutritional characteristics through the use of genetic modification. The failure of the GM approach is underscored by David Lawrence, research director of Syngenta, a leading Swiss-based biotechnology company: "We have conducted many genetic engineering experiments for seed materials and plant protection and they have often failed. On the other hand, excellent results have frequently been achieved with the traditional approach to plant growing" (Die Welt, 2004).

three the 'gm soy republics' of south america

the 'gm soy republics' of south america

carmen améndola and marcelo pereira, redes/
friends of the earth uruguay and juan lópez villar,
friends of the earth international

1. the soy complex

Soybean, native to East Asia, is a very important crop in terms of production and world trade. It is primarily used for animal feed, with only a very small proportion consumed directly by humans. The products derived from soy, however, appear in a large variety of processed foods.

Soy is the main agricultural activity in terms of volume for some of the most advanced economies in South America, including Brazil and Argentina, which rank second and third in global soy production after the United States. In 2005, 258 million tonnes of soybean were produced worldwide. These three countries alone produced around 70% of this total, some 178 million tonnes (USDA, 2006g).

The other important characteristic of soy production is its strong orientation towards export markets. This is particularly true in South American countries. In Paraguay, 65% of the total production of soybeans is exported, and these percentages are even greater in Brazil where 72.4% of the soy crop is exported, and Argentina where the total is a whopping 92%.

TABLE 1 SOYBEAN PRODUCTION AND EXPORTS IN 2005/06 (IN THOUSAND METRIC TONNES)

TOP PRODUCERS	PRODUCTION	EXPORTS	% OF EXPORTS
1. US*	83,368	33,443	> 40%
2. Brazil*	55,000	39,850	> 70%
3. Argentina*	40,500	37,575	> 90%
4. China	16,350	---	
5. India	6,300	---	
6. Paraguay	4,000	2,600	> 60%
7. Canada	3,161	1,310	> 40%
8. Other	9,358	1,539	
Total	258,537	71,749	

** Includes soybean, soy meal and soy oil in the export products.*
***Source:** Based on USDA figures, 2006g.*

The fourth and fifth top producers in the world are China and India, where the combined output of over 20 million tonnes is mainly for domestic use. China, together with the European Union, is also one of the world's major soy importers, absorbing approximately 60% of global soybean imports.

TABLE 2 WORLD'S TOP SOYBEAN IMPORTERS 2005 (IN THOUSAND METRIC TONNES)

TOP IMPORTERS	THOUSAND METRIC
1.China	28,200
2. EU-25	13,900
3. Japan	3,950
4. Mexico	3,725
5. Taiwan	2,400
6. Thailand	1,473
7. Indonesia	1,300
8. Korea	1,200

***Source:** Based on USDA figures, 2006g.*

2. the introduction of gm soy

In terms of regions, GM crops have spread the fastest and widest in North America, followed by South America. The majority of the genetically modified crops that have been introduced in Latin America are soy. Soy has expanded most rapidly in Argentina, where the country's current soybean production is estimated to be 100% genetically modified. In Brazil, it is calculated that Roundup Ready (RR) GM soy accounts for over 30% of the country's overall soybean production.

Argentina was the first South American country to begin cultivating GM crops in 1996, and today is the world's second-ranked GM crop producer after the United States. Uruguay went GM in 1997, but the other two key soy countries in the Southern Cone, Brazil and Paraguay, did not allow GM crops to be planted or imported until more than seven years later. Despite these prohibitions, GM crops were smuggled in and planted over large areas long before these dates. This chapter will explain how RR soy made its way into South America, and uncover the main drivers of this progression.

Soy in South America.

© redes

3. argentina

3.1 global soybean export

Soybeans are the most important crop for Argentina today, and the country is the world's third largest soy producer and exporter. The Argentinian agronomic model is geared almost entirely towards exports. Only 2% of harvested soybeans, for example, are destined for the national market, whereas 30% are exported as grain and 68% are processed by the national oilseed industry (USDA, 2005c).

Since the early 1990s, when it already held 13.4% of the world market, Argentina has become the leading global exporter of soy oil and a top player in soymeal (USDA/ERS, 2001). Argentina sells 40% of the world's soy oil and 34% of total global soy by-products. Soybean is a very important source of revenue for the government, which applies a 20% export tax on soy oil and soymeal, and a 23.5% tax on soybeans (USDA, 2006j). The export of products made from soybean accounted for one-fourth of Argentina's export earnings in 2003, and soybean exports have increased by 125% since 1997 (Benbrook, 2005). The federal government manages this revenue (USDA, 2006j).

3.2 speedy adoption of gm soy

Argentina has been a pioneer in the introduction of GM crops, both in Latin America and in the rest of the world. In 1996, Argentina approved GM soy for the first time (Argenbio, 2005). Monsanto introduced the technology into the country's market through licensing and technology transfer agreements with local seed companies (Monsanto, 2005f). These seed companies were immediately granted the title to plant varieties incorporating the Roundup Ready gene (Argentinian government, 2005a).

The introduction of GM soy in the country was accomplished very quickly, from less than 10% of total area in 1996 to over 90% in 2001 (ASA, 2005). In 2004, some 16 million hectares of GM crops, 90% of them Monsanto's Roundup Ready soybeans, were planted in Argentina. This was the most comprehensive adoption of GM soy in the world, with 98% of national soy production based on a genetically modified variety (James, 2004, 2003; Morales, 2001). That same year, more than 1.5 million hectares of GM corn were also cultivated, representing over 50% of the country's total area planted with corn. In 2006-07, the estimated soy coverage is 15.6 million hectares (SAGPYA, 2006).

The economic and agronomic factors for GM corn were not as favorable as they were for soy, and adoption was thus less widespread. As was reported in the Argentinian newspaper La Nación, "to sow and protect an hectare of maize needs at least three times as much investment as does the equivalent of soy" (La Nacion, 2003).

In 2005, ten GM crop varieties were authorized for production and commercialization in Argentina: one soybean (Monsanto 40-3-2); two cotton (Monsanto 531 and 1445); and seven corn (Ciba-Geigy 176, AgrEvo T 25, Monsanto 810 and NK 603, Novartis Bt11, Syngenta GA 21 and Dow/Pioneer TC 1507). Other crop species have thus far not been authorized, and a GM canola event application for field trial was rejected because of potential genetic introgression with wild relatives, among other reasons (CONABIO, 1996).

3.3 environmental and socio-economic impacts

Argentina was once a granary of the world and an exporter of wheat, maize and meat for human consumption. Today, thanks to the GM soy revolution, the country has primarily become a producer and exporter of oil and feed for European and Asian cattle. Export-oriented agricultural policies, adopted in the late 1970s and intensified during the 1990s, have turned Argentina into a huge grower of GM soy monocultures.

Roundup Ready soy facilitates weed control, one of the main problems for farmers. While effective non-chemical options exist, applying herbicides is simpler for most farmers, particularly when associated with a no-till planting system. The technological package offered with GM seeds, accompanied by reduced prices for herbicides, is thus very attractive for Argentinian farmers. However, the move from 6 million hectares in 1997 to 14.2 million hectares in 2004 has been accompanied by significant negative environmental and social impacts. The intensification of soy production has been associated with soil erosion and a decline in soil fertility in agricultural areas. It is predicted that Argentinian soil will be totally depleted in 50 years at current rates of nutrient depletion from soy cultivation (Pengue and Altieri, 2005).

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As the area covered with Roundup Ready soybeans has grown, the use of glyphosate has increased dramatically, to 160 million liters in 2004. This has accelerated the emergence of genetically resistant weeds that need increasing dosages of glyphosate; some farmers are even combining glyphosate with other herbicides in order to deal with difficult-to-control weeds (Pengue, 2005; Benbrook, 2005).

The transformation of the rural sector and the landscape is notable. Soy has displaced other crops and livestock, such as vegetables, fruit, and cattle. In the Pampas region, for example, 4.6 million hectares of land previously dedicated to dairy, fruit trees and other horticulture, cattle and grain has been displaced by soybean production since 2004. Areas planted with sunflowers have been reduced by 9.6%, and areas cultivated with maize by 5.6% (Pengue, 2005).

The introduction of GM soy has also contributed to the acceleration of land consolidation in Argentina. The intensification of agriculture since the 1990s has created many indebted farmers who must repay bank loans at high interest rates. An estimated 14 million hectares are mortgaged with outstanding loans from banks and big companies. This has enabled the establishment of large holdings and the disappearance of smaller farms (Desafios Urbanos, 2005). During the 1990s, the number of farms in the Pampas area decreased from 170,000 to 116,000, while the average size of farms doubled (Pengue, 2005).

The expansion of soy in Argentina is a clear example of the conflict between environmental, social and economic priorities. Soybean exports are an important source of government tax receipts. However, it is clear that short-term economic objectives are taking precedence over medium and long-term environmental and social concerns.

What are the limits of soybean expansion in Argentina? Agricultural officials in several parts of the world report that the country will soon reach its limits. In order to further expand soybean production, yields must be improved or area must be appropriated from other crops. Both avenues could prove challenging. A USDA report describes the limited opportunities for soybean cropland expansion in Argentina: "A rise in Argentine soybean production would have to rely mainly on improving yields (which are already comparable with US yields) or attracting area away from other crops" (USDA/ERS, 2006b).

Another key question that must be answered is this: who reaps the economic gains of soybean expansion? Benbrook, in his evaluation of Argentina's GM soy revolution, concludes that "the economic gains stemming from a somewhat larger share of world soybean exports will do relatively little to improve the quality of life for most people in the country" (Benbrook, 2005).

3.4 monsanto's aggressive collection of gm soy royalties

Argentinian farmers, unlike their North American counterparts, were able to use GM soy with no intellectual property rights restrictions or royalties attached. Although Monsanto applied for patent protection of its Roundup Ready soy in Argentina in 1995, this was never granted. In 1996, the company brought GM technology onto the market through licensing and technology transfer agreements with local seed companies. In 1999, Monsanto started to commercialize its own varieties of Roundup Ready soy. In 2001, the company's request for a patent on Roundup Ready soy was officially denied in a Supreme Court decision (Monsanto, 2005f,g). At that time, Monsanto and other seed companies, eager to gain access to the Argentinian market, chose not to pressure the government to change seed patent laws so that they could collect royalties (Benbrook, 2005).

In the meantime, with the expiration of Roundup patent protection in the US in late 2000, prices for the chemical plummeted by more than 50%, and Monsanto lost over one-third of its market share due to competition from Europe and China (UBS, 2004).

In response, the company started to advocate a new royalty collection system for Roundup Ready soy. As Frank Mitsch, an analyst at Fulcrum Global Partners in New York, said: "they're going after [royalties] a bit more aggressively now than perhaps they had in the past because they realize they may be losing some business on their chemical side" (Reuters, 2004e).

Argentinian farmers can store GM soy seeds from one season to the next without paying anything to Monsanto (Dow Jones, 2004). US farm organizations such as the American Soybean Association complained that this gave Argentinian farmers an unfair competitive advantage over their North American counterparts (Reuters, 2004e). In 2003, due to meager profits from its soy seed business in Argentina, Monsanto decided to discontinue its soy improvement program there (Monsanto,

2005f). The company also complained that as GM soybean seeds were widely traded on the black market, the mechanism of building royalty fees into seed prices was not working.

In 2003, Monsanto began to consider a new licensing scheme, based on intellectual property rights systems in countries importing soy containing Roundup Ready technology (Monsanto, 2005f). By this time, Monsanto was clearly pressing for the introduction of a new ‘technology fee’ for GM crops, something alien to South American legal systems up to that time (Bravo, 2005). The company took out huge advertisements in Argentinian newspapers, calling for the creation of a new royalties payment system (Dow Jones, 2004a). In 2004, Monsanto openly communicated its intention to implement royalty collection systems in importing countries.

In May 2004, Argentina’s National Seed Institute implemented a resolution requiring that each sack of seed be labeled with quantity, unit price, total sales price, and seed species, type or variety. However, Monsanto was not satisfied, claiming that seeds continued to be sold illegally. In an October 2005 report, the US Department of Agriculture praised Argentina’s support for GM crops, but also voiced strong criticism of the Argentinian intellectual property system saying that: “Argentina is a major producer and exporter of agricultural biotechnology products, yet it does not have an adequate and effective system in place to protect the intellectual property rights of new plant varieties or plant-related technology. Penalties for unauthorized use of protected seed varieties are negligible. Judicial enforcement procedures in Argentina likewise are ineffective as a mechanism to prevent the unauthorized, commercial use of protected varieties” (USDA, 2005c). In order to resolve the controversy, proposals to limit Argentinian farmers’ rights to save seeds for their own use were put forth. The Secretary of Agriculture, Miguel Campos, was a proponent of this approach. Farmers’ organizations, however, were opposed: the Argentinian Agricultural Federation stated that this would constitute the “unacceptable elimination of an inherent right of our farmers” (El Tribuno de Salta, 2005).

Monsanto worked with the Seed Association in Argentina (ASA) and the national Plant Protection Association to this end, presenting several proposals including a compensation of 1% of the value of a tonne of soy for the next two years, and an increase of up to 4% with the 2006/2007 harvest (Monsanto, 2005f,g). The Argentinian government opposed Monsanto’s proposals, accusing the company of abuse (La Nacion, 2005). Secretary of Agriculture Campos, a strong supporter of GM crops, said that Monsanto made a good deal of money in the country and should not impose itself unfairly on Argentine farmers: “The great beneficiary of this has been Monsanto. Argentina has been the launching point for the use of this technology in the continent. This has allowed Monsanto to make advances in other countries” (Dow Jones, 2004a).

3.5 pressure on european soy imports

The conflict heated up in June 2005, when Monsanto filed lawsuits regarding the shipment of Argentinian soybean products to the Netherlands and Denmark, arguing a possible infringement of its patent rights on the Roundup Ready gene in Europe.

TABLE 3 ARGENTINE EXPORTS OF SOYMEAL TO THE EUROPEAN UNION (IN THOUSAND TONNES)

EU COUNTRIES	SOYA BY-PRODUCTS 2006*	2005	2004	2003	2002	2001	2000
Poland	401	1,185	643	490	192	112	9
Netherlands	1,187	2,974	2,566	2,476	2,234	1,647	1,171
Germany	99	186	241	330	354	499	336
Belgium	148	352	254	382	433	339	496
Denmark	426	1,426	1,209	1,343	1,299	1,043	1,007
Slovenia	45	21	6	22	6	39	9
Spain	1,151	3,417	2,852	2,820	2,213	1,892	1,682
France	384	417	287	496	269	146	625
Greece	91	137	236	271	212	122	202
Ireland	157	301	230	344	160	113	92
Italy	719	2,244	2,094	2,280	2,380	2,421	2,062
Lithuania	80	78	16			2	
Portugal	26	81	147	221	236	174	332
United Kingdom	84	138	50	100	88	80	53
Total	4,998	12,957	10,831	11,575	10,076	8,629	8,076

Source: *INDEC, Argentina. * As of April 2006.*

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Argentina's economic stakes in this issue are huge. EU member states import around 50 million tonnes of feed each year, 10 million of which are from Argentina (FEFAC, 2004).

Annually, the European Union imports 99% of the soy and soy by-products it uses for feed purposes from third countries, primarily Argentina and Brazil. Argentina supplies 52.4 % of the EU's total imports, and the total volume of soymeal exports to the EU during the 2005/06 period was around 14 million tonnes.

In this context, the Argentinian Agriculture Secretary toured Europe in October 2005, seeking support for the country's case. The European feed industry stated its neutrality in the dispute, but firmly communicated that it would not pay royalties related to GM soy as no advantage is derived from the presence of the Roundup Ready gene: "The European feed industry, using up to 10 million tonnes of soybean meal from Argentina annually, has no direct advantage from the presence of residues of herbicide-resistant genes in the products they buy. The industry is therefore not prepared to pay for the use of this technology" (FEFAC, 2005).

Monsanto holds the European patent for transgenic soy, which was granted in connection with the glyphosate tolerance of the company's GM soybean. According to Monsanto, the soymeal imported to Europe from Argentina infringes the European patent, as it contains parts of the patented DNA sequence claimed in the patent as well as the enzyme CP-4-EPSPS. In 2005, Monsanto took samples of Argentinian soymeal as transport ships arrived at customs points in Denmark and Holland, implying that they were claiming property rights not just for the seeds themselves but for the products obtained from the seeds (Argentinian government, 2005a,b).

Monsanto initiated legal actions under Regulation 1383/2003 to allow customs offices to detain shipments of Argentinian soymeal arriving at European ports. This regulation allows customs offices to hold goods originating from third countries that are suspected of infringing intellectual property rights. Goods can be detained for 10 days, and this period can be extended if the alleged right holder - Monsanto in this case - decides to initiate legal proceedings at the national level. If no legal proceedings are initiated, the customs office will release the goods. If a court case is initiated, the importer can release the goods upon the provision of a security which "must be sufficient to protect the interests of the right holder".

By alleging that the provisions of EU Biotech Patent Directive 98/44 were violated, Monsanto was able to stop an average of one ship per week during a period of several months in 2006. The main European ports for soymeal export include Bilbao, Santander, Cartagena, Coruña and Huelva in Spain; Rotterdam in the Netherlands; Copenhagen in Denmark; Hamburg and Frankfurt in Germany; and Antwerp in Belgium (Argentinian government, Factual Note 2006). Monsanto filed several court cases in Europe following these detainments: three in Spain, one in the Netherlands and one in Denmark.

Monsanto has offered to drop the court cases if importers agree to buy licenses in exchange for paying royalties. The company wants importers to pay them about US$15 per tonne as a compensatory fee when importing soybeans from Argentina. Although the importers have thus far refused to pay, having their ships detained for 10 days costs them dearly, with some estimates as high as €800,000 (US$1,046,479) for that period. Moreover, if a court case ensues, importers must pay a security in order to have the soymeal released. In Spain, one importer paid some €6 million (US$7.8 million) as a security (personal communication between FoEI and Argentinian government official, 2006).

The Argentinian government considers Monsanto's actions as an abuse of intellectual property protection rights, and has met with EU officials on several occasions. In September 2005, Argentinian Agriculture Secretary Miguel Campos and Argentinian exporters met with EU Agriculture Commissioner Marian Fischer Boel. In March 2006, the Argentinians visited again and presented the Commission with a report on the situation. They called upon the EU to open an investigation to ascertain whether Monsanto's actions are abusive and monopoly-related. In June 2006, Argentina threatened to sue Monsanto in Europe after more shipments were stopped in Spain.

In August 2006, the Argentinian government reported that the European Commission had backed Argentina's position through an opinion letter from the Commission's Internal Market and Services Directorate General. The Commission's legal experts found that EU law does not extend to derivatives of patented products. However, since the opinion is not binding within national courts, Monsanto has dismissed its significance (Marketwatch, 2006).

Thus far no agreement has been reached, but Monsanto continues to push for "a solution to this conflict that affects the soy and wheat business, among others, since it is essential to make Argentina attract new investments in germoplasm and biotechnology, from national and international companies" (Monsanto, 2006f).

4. brazil's soy sector in crisis

4.1 the importance of soy for brazil

Soy is the main agricultural activity of Brazil in terms of volume and income generation, with over 243,000 producers spread among 17 states. The area of land devoted to soy production in Brazil has grown at an average of 3.2%, or approximately 320,000 hectares, per year since 1995. Soy covers the largest area of any crop in Brazil, occupying 21% of total cultivated land (Altieri and Pengue, 2005). The soybean complex (soybean, soymeal and soy oil) is also a major source of foreign exchange, accounting for around 10% of total Brazilian exports. The majority of domestic production and exports are dedicated to feedstock (ABIOVE, 2006a).

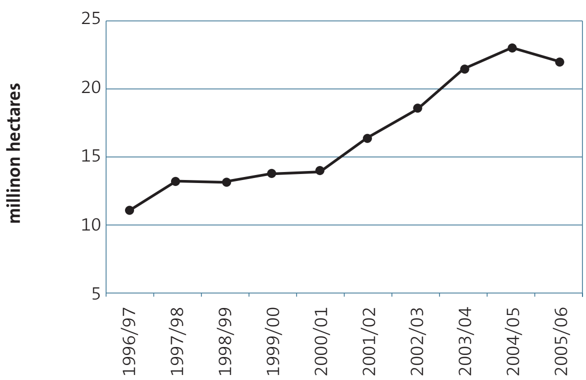
Brazil is the second largest soy producer in the world after the United States. In 2005/06, the soybean production area was reduced for the first time in eight years of constant growing to total slightly more than 22 million hectares (CONAB, 2005a, 2006c). In 2006/07, the forecast is to plant between 20.5 and 21.1 million hectares, a reduction of between 5.1 and 7.6% due to the debt acquired by farmers over the last three years. CONAB, the national food supply company, expects however higher production levels despite the reduction in area as it believes farmers will cultivate in the most productive areas (CONAB, 2006b). Estimates of the percentage of GM soy in comparison to the total area planted with soy range between 20 and 35% (Batista, 2004; Monsanto, 2006e).

TABLE 4 AREA, YIELD AND PRODUCTION OF SOY IN BRAZIL, 2000- 2006

	2000/01	2001/02	2002/03	2003/04	2004/05 PRELIMINARY	2005/06 FORECAST
Area (in thousand hectares)	13,969.8	16,329.0	18,474.8	21,375.8	23,301.1	22,229.2
Yield (kilogram/hectare)	2,751	2,567	2,816	2,329	2,208	2,403
Production (in thousand metric tonnes)	38,431.8	41,916.9	52,017.5	49,792.7	51,452.0	53,426.0

Source: *CONAB, 2006a.*

FIGURE 1 AREA PLANTED WITH SOYBEAN IN BRAZIL, 1996-2006



Source: *USDA, 2006n.*

4.2 hard times for brazilian soy farmers

Since 2004, the soybean sector in Brazil has been in crisis and soy farmers are having a difficult time sustaining their livelihoods. The cause of the crisis is a combination of low international soy prices, rising costs for inputs and transportation, a strong Real, which makes exports cheaper, rust and drought.

In April 2006, soybean farmers blockaded roads in Mato Grosso, Paraná, and Rio Grande do Sul, demanding minimum price guarantees for their crops. This amount was approximately US$115 per metric tonne at the time of the protest, as farmers estimated their production costs to be around US$230 per metric tonne.

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High energy prices have had a significant impact on soybean farmers in the central-western part of Brazil, as fuel oil cost increases strongly impacted fertilizer and freight prices. It was reported that in Mato Grosso, freight rose from US$55 per tonne to more than US$88 per tonne (ABIOVE, 2006a). This has direct ramifications for farmers: for example, soybean farmers in Mato Grosso will receive just over half the price of their soybeans in 2006 because the other half is spent in transporting their crop 1500 miles by truck to the closest port (USDA, 2006e).

The increase of agrochemical costs due to rust is another important element in the crisis. RR soy does not offer protection against rust, a fungal disease that has severely affected soybeans. In January, the government of Brazil made $200 million Real available for emergency loans to combat rust, but the damage has nonetheless been significant. Embrapa, the Brazilian Agricultural Research Corporation, estimates that half of the total 2006 soy losses are due to rust, with an estimated cost of US$1.7 billion (USDA, 2006e). Farmers have been severely affected, as their input costs have risen at a time when their profit margins were already small. Additional costs generated during the 2006 crop in Mato Grosso were an estimated US$70 per hectare (ABIOVE, 2006a,b). The resulting additional use of pesticides has also affected both the yield and the environmental impact, as the soybean leaves are burned by the spray.

In 2006, the southern states in particular were seriously threatened by drought. Paraná is the second largest soybean producing state in Brazil, and together with Rio Grande do Sul it accounts for about one-sixth of the total area planted with soybeans in Brazil. In 2006, this area declined by about 400,000 hectares due to the difficulties encountered over the previous two years.

The appreciation of the Real by more than 30% in relation to the US dollar in 2005-06 also played an important part in the crisis (ABIOVE, 2006a,b). As a result, despite the fact that the volume of exports was greater in 2006 than in 2005, the value of the products decreased.

TABLE 5 SOYBEAN COMPLEX EXPORTS

YEAR	VOLUME (IN 1000 TONNES)	PRICE (US$/TONNE)	VALUE (US$ MILLION)
2006			
Soybean	25.2	225	5.67
Soymeal	12.4	195	2.418
Soy oil	2.2	480	1.056
Total	39.8	900	9.144
2005			
Soybean	22.435	238	5.345
Soymeal	14.422	199	2.865
Soy oil	2.743	462	1.267
Total	39.6	899	9.477
2004			
Soybean	19.248	280	5.395
Soymeal	14.486	226	3.271
Soy oil	2.517	549	1.382
Total	36.2	1055	10.048

Source: *Based on ABIOVE, 2006.*
http://www.abiove.com.br/english/exporta_us.html

In response to these problems, the federal government adopted an emergency credit package of US$8 billion to help farmers cope. This will cost Brazilian taxpayers an estimated US$705 million. Farmers' leaders, however, find the emergency package insufficient, as they estimate the total loss suffered by farmers over the previous two growing seasons at US$14 billion (USDA, 2006e,f). The government is also proposing other subsidies and measures, such as the reduction of import duties for agricultural inputs, and an increased budget for crop insurance.

The farmers' prospects for planting in 2007 do not appear any better. According to the US Department of Agriculture, the area cultivated will depend both on the amount and accessibility of credit for Brazilian farmers and the US soybean crop, as global prices are highly dependent upon decisions made by US farmers (USDA, 2006e).


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Amazonian area deforested by soy plantation.

hard times for brazilian soybean farmers

"Soybean producers throughout Brazil commented that credit was tight this year and more difficult to obtain in general. Multinational grain trading companies, on which an estimated 70 percent of commercial soybean farmers depend for annual crop production financing, reportedly reduced their overall lending levels and more carefully scrutinized farmer's business operations. Producers who defaulted on loans in 2004/05 reportedly found it difficult if not impossible to obtain credit this year from these companies. Farmers who could not obtain adequate production financing reportedly reduced soybean area, diverted land to other crops, or rented their land to growers who could obtain credit.

The net result of the widely publicized credit squeeze, however, was only a marginal reduction in actual soybean plantings. The vast majority of producers found a way to plant this year, with or without credit. In doing so, many risked compounding their existing indebtedness in the hope that improved profitability later this year would help them recover some of the financial losses incurred in the past two years.

Their strategy during a year of tight to negligible profit margins required them to achieve high crop yields while also reducing their production costs. They also needed the national currency to stabilize or weaken against the US dollar, to support domestic soybean prices. Unfortunately, the Brazilian currency (Real) did the opposite and strengthened during the growing season, causing internal soybean prices to fall below the cost of production in many areas.

At current market prices, a significant number of producers across the country will see potential profits disappear entirely this year. In the major Center-West producing states of Mato Grosso and Goias, growers experienced a substantial increase in their production costs owing to higher fuel, fertilizer, fungicide, and transportation prices. Despite their success in achieving high crop yields, producers watched a strengthening currency erode regional soybean prices to the point that they fell below their production costs.

Soybean growers in Rio Grande do Sul, Santa Catarina, and Parana by comparison had healthy potential gross margins at planting, largely owing to their close vicinity to major ports and their comparatively low transport costs. But farmers in these regions also saw their profits dissipate or disappear when the currency strengthened and crop yields were reduced by drought. If prices don't improve soon, farmers all across the country face the prospect of a second year of poor to negative soybean profitability, with the likelihood that the debt and credit problem will only intensify in 2006."

Source: *USDA, 2006n.*

4.3 ban, smuggling, and legalization: the story of soy in brazil

In 1998, Monsanto's Roundup Ready soy was approved for commercial purposes by the Brazilian authority in charge of dealing with GMO applications, the National Technical Commission on Biosafety (CTNBio). Planting could not proceed, however, as Greenpeace and the Institute for the Defense of Consumers (IDEC) won a lawsuit in September 1998 prohibiting the commercial use of GM soybeans until a full environmental impact study had been carried out. In 1999, this preliminary decision was confirmed when a federal judge suspended the cultivation of GM soy until an environmental study had been conducted, foiling Monsanto's plans to legally market Roundup Ready soybean seeds in Brazil in time for the 2000 harvest (Cardoso, 2003).

Although cultivation was illegal during this period, there was a growing awareness that GM seeds had been planted in the south of Brazil. In Rio Grande do Sul, for example, it was estimated that up to 60% of the total crop was genetically modified (Reuters, 2003b). Despite the ban, seeds were being smuggled in from Argentina and quickly entering Brazilian fields. Field trials and demonstration areas have also provided seeds for illegal growing (Marinho and Minayo-Gomez, 2004).

During the 2002 elections, candidate Lula da Silva vowed to maintain the ban on GMOs and to support GMO-free production in Brazil. Lula's agricultural policy advisor stated: "We want to establish a reputation as GM-free. We get premium prices on specialty markets that our competitors - the US and Argentina - don't because they plant GM" (Swing, 2002). However, immediately after Lula came to power, his

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government cleared the path towards legalization of GM crops in the country. At the end of 2002, the Minister of Agriculture, Roberto Rodrigues, said: "We need to give Brazilian farmers the chance to use GM crops," and stated that such crops could help combat famine by reducing food prices (Reuters, 2002).

Some accused Monsanto of supporting the smuggling of GM soy from Argentina in order to contaminate crops so that the way would be smoothed for eventual legalization. In any case, it is not clear how GM soy penetrated into Rio Grande do Sul, but that the contamination was widespread is undisputed.

In this context, the Lula government temporarily authorized GM soybeans through a provisional decree in March 2003 (Reuters, 2003b). The decree did not allow seed to be planted that year, but aimed to legalize GM soybean cultivation by the 2003 harvest. At this stage, Monsanto stepped up its lobbying and pressure activities. In June 2003, for example, the US government invited a group of 20 Brazilian politicians and scientists for a study visit on the use of GM crops in the US and South Africa, which included meetings with Monsanto executives (The Financial Times, 2003).

This illegal introduction and forced legalization of GM crops took place at a time when most of the Brazilian population was opposed to GM crops until they had been proven safe. In a December 2003 survey by the Brazilian Institute of Public Opinion, 73% of respondents stated that they were against deregulating the cultivation of GM crops until it was known that they were safe for human health and the environment.

In March 2005, a law establishing the new national biosafety requirements was adopted (Law 11, 2005). The consumers' association, the environmental ministry and a wide range of stakeholders including the Episcopal Conference of the Catholic Church were all disappointed with the new legislation. The law does not respect the precautionary principle and contains no liability rules. Civil servants from the Brazilian Ministry of Environment protested that the new biosafety law was not what they had hoped for, and that it was weakened by other forces influencing the legislative process in the Brazilian Congress (Canes, 2005). Indeed, in its press release welcoming the new law, Monsanto confirmed that it was "encouraged" by its enactment (Monsanto, 2005a; Reuters, 2005).

In addition, Beto Ferreira Martins Vasconcelos, a lawyer who had worked from 1998 to 2002 for Monsanto, became involved in the working group in charge of establishing the decree to implement the biosafety law (Folha de São Paulo, 2005; ASPTA, 2005). Although many in Brazil argued that there was a conflict of interests, he was not removed from his regulatory position. At the end of 2006, Vasconcelos was the executive secretary of the National Biosafety Council, composed of 11 state ministers.

4.4 gm crops authorized

To date, two GM varieties have been authorized in Brazil. In addition to soy, a Monsanto GM cotton was legalized in March 2005 (see chapter 4). The Ministry of Environment and environmental NGOs have opposed the release of GM cottonseed due to the possibility that it could cross with native cotton species. The National Technical Commission on Biosafety has required Monsanto to prepare an impact study on the effects of planting the GM cottonseed, so it will likely not be sold before 2007 (USDA, 2005e).

GM corn has been authorized for import, but only as animal feed and not for cultivation. The pork and poultry industry has already requested the segregation of imported GM corn in order to avoid problems with exports to the EU (USDA, 2005e). Echoing the soy episode, however, it is suspected that corn was illegally introduced into Brazil as a company in Rio Grande do Sul has reportedly been selling GM corn smuggled from Argentina. In November 2005, Brazilian deputy Frei Sérgio Antônio Görgen presented a complaint at the Federal Public Ministry about this contamination (Massarini, 2005). Fewer and fewer people believe that the contamination is just accidental, as both the soy and corn releases have coincided with Monsanto's push to legalize these crops (Valor Economico, 2005).

4.5 gmo prohibition in indigenous areas and new rules for protected areas

In October 2006, the government introduced new restrictions for the planting of GM crops in Brazil by modifying Law 11.105/05. According to legal measure 327, it will be forbidden to plant GMOs in indigenous territories (Presidencia da Republica Brazil, 2006a).

The same legal measure introduced some less positive modifications to protected areas (called Unidades de Conservação, or SU). The earlier law approved in 2003 had forbidden the planting of GM soy in the buffer zones

surrounding the SU protected areas, but the proposed modifications of the new legal measure reverse this prohibition and mandate the Brazilian president to decide how close GM soy can be planted to protected areas (Greenpeace, 2006d). For many civil society organizations and social movements, this proposal to modify the law is an attempt to legalize the illegal activities of GM growers, and demonstrates that the government is neither capable or willing to implement its own rules (Brazilian NGOs, 2006).

In early 2006, the Brazilian Institute for Environment and Renewable Natural Resources (IBAMA) handed Syngenta a $1 million Real (US$462,791) fine and launched a case against the company for planting GM crops in the municipality of Santa Tereza do Oeste, four kilometers from the Iguazu National Park. Syngenta was using the 143 hectare area to experiment with GM soy and corn. The area has now been expropriated by the governor of Paraná, and will be used to build a research center for organic agriculture and agroecology (ASPTA, 2006a).

4.6 corporate strategies

Since 2003, Monsanto’s campaign has gathered steam both nationally and internationally. In 2005, a Brazilian government delegation played a pivotal role at the Second Meeting of the Parties to the UN Biosafety Protocol in undermining an international decision that would have put in place a mechanism for the identification and labeling of GMOs. Just what happened during the final days of this meeting has not yet been convincingly explained to Brazilian civil society organizations, and many believe that biotech industry representatives strongly influenced the Brazilian delegation. Joaquim Machado, a Syngenta employee, was often seen talking to Hadil Fontes da Rocha Vianna, head of the Brazilian delegation, and was even seated beside him during the official sessions. In fact, some Brazilian government representatives complained that Machado had better access than they did to Vianna. In general, members of the official delegation refused to talk to the independent Brazilian observers who were present (ASPTA, 2005b).

In April 2005, Monsanto launched an awareness campaign in public schools all over the country. With the support of the Ministry of Culture, the company developed a ‘social responsibility’ project that would have promoted GM crops in classroom material about agriculture and environment. The plan was to train 560 schoolteachers on using the material. Fortunately, after an intensive campaign was launched against the program, the Minister of Culture put an end to it (GM Free Brazil, 2005).

the things monsanto says...

Imagine a world that preserves nature, air and rivers. A world where we can produce more with fewer pesticides, without deforestation. Imagine a world with more nutritious and great quantities of food, and healthier people. Did you ever think about that? You never imagined GM crops could help with this? Did you ever think of a better world? You are thinking like us.

Monsanto advertisement released in Brazil in 2004.

In addition, Monsanto cooperates with Embrapa - the Brazilian Agricultural Research Corporation - and made a $800,000 Real (US$369,000) donation in 2006 to finance biotechnology projects in Brazil. One of the projects Embrapa plans to develop is the use of Roundup Ready Flex in cotton, which has already been commercialized in the United States (ASPTA, 2006a).

4.7 the fight over royalties: the imposition of the dual payment system

Echoing the Argentinian experience, US farm groups and Monsanto started to agitate for the issue of Brazilian royalties in 2003. US farm organizations complained that Brazilian farmers, who did not have to pay for Roundup Ready technology, were receiving an unfair advantage. The American Soybean Association (ASA), for example, argued that Brazilian growers earned between US$9.30 and $15.50 more per acre than US growers (OsterDowJones, 2003; Reuters, 2003c,d).

In March 2003, after the provisional measure authorizing the commercialization of GM soy was adopted, Monsanto launched an aggressive campaign to make farmers aware of their duty to pay royalties for the use of Roundup Ready soybeans. The company took out newspaper advertisements stating that: “Independent of the process of lifting the ban, producers that plant Roundup Ready soy ought to consider paying for the use of the technology at the time of sale of the production” (Reuters, 2003c). Pressure from US farm groups continued in the wake of the second decree in September of 2003, which authorized farmers holding illegal seed to plant GM soybeans in the

2003/04 season. American Soybean Association President Ron Heck stated in tough terms: "I am very skeptical. Just because it's a law in Brazil doesn't mean that there will be any enforcement. Growers have been illegally planting pirated Roundup Ready soybean seed right under the government's nose for more than six years" (ASA, 2003).

Monsanto's campaign produced its first results in 2004, when the company started collecting royalty fees from growers in southern Brazil who used Roundup Ready soybeans. Monsanto devised a detection system in which more than 95% of the grain elevator companies in two southern Brazilian states (Rio Grande do Sul and Santa Catarina) test incoming soybeans for the presence of Monsanto's trait. If the trait is detected, the grain elevator company shares the technology fee with Monsanto (UBS, 2004; Reuters, 2004a). According to Reuters, farmers in Rio Grande do Sul agreed to pay $10 Real (US$3.50) per tonne to Monsanto upon delivery of the 2003/04 harvest to grain elevators (Reuters, 2004a).

According to the US Department of Agriculture, 98% of grain handlers (elevators, processors, crushers and grower co-ops) in the southern states of Brazil have signed contracts with Monsanto to collect royalties for GM technology in incoming crops. In 2004, royalties increased to $20 Real per tonne (US$7). If farmers do not declare their soybeans as genetically modified, their load is tested on site. If the Roundup Ready trait is detected, they are subject to the normal fee plus a penalty (USDA, 2004).

For the 2005/6 season, according to the US Department of Agriculture, Monsanto reached an agreement with farmers' organizations that a post-harvest fee would be collected: 1% for declared soybeans, and 3% for non-declared soybeans.

In 2005, Monsanto and the Brazilian Association of Seeds (Abrasem) reached an additional agreement on royalties per bag of Roundup Ready soy. Monsanto announced in June that it would charge a royalty fee of $0.88 Real (US$0.38) per kilo of certified seed (Monsanto, 2005h). Despite the agreement with Abrasem, the Seed Producers Association of Rio Grande do Sul State (Apassul) rejected this double royalty payment. "If Monsanto continues to permit producers to pay a 2% royalty at the point of sale, but at the same time tries to charge $0.88 Real per kilo for legal seed royalties, it will encourage producers to buy GMO soy seed on the black market," said Apassul president Narciso Barison Neto (Reuters, 2005b).

In this context, according to US Department of Agriculture reports, royalty fees were then lowered to $0.77 Real per kilo at the request of the Brazilian Seed Producers Association. In addition, producers in Rio Grande do Sul have argued that poor crops over the past two years have cut returns so that the fee for 2005/06 should be based on 2% of the value of production. Thus it remains to be seen whether Monsanto will succeed in implementing royalties upon seed bags (USDA, 2005i).

4.8 monsanto lowers expectations for brazil

The dual payment system operated in Brazil throughout 2006. Some 20% of the total royalties were obtained from new seed sales, and the remaining 80% were collected when harvests were delivered to grain elevators.

However, Monsanto was forced to reduce its expectations due to the reduced harvest and yields. In light of this situation, Monsanto believes that the best way to adjust to the reality of the dual system "lies in increasing penetration".

A key strategy for Monsanto in its further penetration of the Brazilian soy market is the creation of a new incentive system that entices farmers to purchase new certified seed. The profits from new seed sales are more secure than the collection of royalties at grain elevators, since the price, including royalties, is fixed and independent of the harvest. Monsanto believes that if it could double sales of new seed the market would be more viable (Monsanto, 2006d,e). The company is striving for 20 million hectares of GM soy, 16 million hectares of GM maize, and 2 million hectares of GM cotton by 2010 (Monsanto, 2006i).

Recent reports indicate that the Brazilian Association of Seeds (Abrasem) and others are criticizing the government for allowing illegal GM seeds to be grown. Abrasem is trying to promote the purchase of certified seed, which it has in storage, but most farmers prefer saving their seeds to buying new ones (Correio do Povo, 2006; Gazeta Mercantile, 2006b). This push for marketing certified seed seemed to be validated in a recent USDA report: "Certified soybean seed producers are reportedly bulking up the supply this season, and will devote an increasing amount of irrigated area to GMO seed production this winter as they prepare to meet demand for the 2006/07 growing season" (USDA, 2006n). Ultimately, the complexity of Brazilian soybean farming in 2006 forced Monsanto to scale down its expectations there for the short term (Monsanto 2006d,e).

Deforested areas in the Amazon.

4.9 environmental impacts: moratorium on soy from deforested amazon

One of the most striking consequences of soy expansion in Brazil - which has the second largest tract of forest in the world - has been deforestation. In Brazil, the cerrado (savanna) has been particularly affected by the advance of soy. Large-scale cultivation degrades soil, particularly in areas that are intensively farmed, and it has been verified that Amazonian soils are rendered unproductive by large-scale monocultures (Altieri and Pengue, 2005).

Several reports in 2006 confirmed that cropland expansion, particularly soy, has been a major cause of new deforestation in the Amazon in recent years. A new scientific study by US and Brazilian universities directly links the rapid growth of soy cultivation with the expansion of the "arc of deforestation" along the southern and eastern borders of the Brazilian Amazon, which is the "most active land-use frontier in the world in terms of total forest loss". It was previously believed that deforestation in the Amazon was primarily derived from large-scale cattle ranching operations, small-scale timber exploration and subsistence agriculture; however, this new study clearly signals the shift towards large-scale agriculture as a growing factor in deforestation in Brazil (Morton et al., 2006).

In July 2006, a two-year moratorium on soybeans from deforested areas of the Amazon was accepted by major soybean traders including ADM, Cargill and Bunge (IPS, 2006). As a result, farmers who own land cleared after 24 July 2006 in the Amazon forest - excluding El Cerrado and transitional forest zones - will not be able to sell their soy to those companies (USDA, 2006d).

While this moratorium may put brakes on the planting of soy in the Amazon, this measure has been criticized by some Brazilian sectors as weak, and not a solution to the unsustainable soy production in the entire country (Santilli, 2006).

Today, 88% (5.3 million hectares) of the legal soybean area in the Amazon is concentrated in Mato Grosso, the major soybean producing state (ABIOVE, 2006b). Between 2001 and 2004, Mato Grosso accounted for 87% of the increase in cropland area and 40% of new deforestation. Deforestation in the state for large-scale cropland constituted 17% of total forest loss in large clearings during this same period (Morton et al., 2006).

Statement from the Brazilian Association of Vegetable Oil Industries and the National Association of Grain Exporters

"The Brazilian Association of Vegetable Oil Industries and the National Association of Grain Exporters and their respective members are committed to the implementation of a governance program, the objective of which is not to trade soy from the crop that will be planted as of October 2006 coming from areas within the Amazon biome that are deforested after the date of this announcement.

This initiative, which will last for two years, seeks to reconcile environmental conservation with economic development, through the responsible and sustainable use of Brazil's natural resources. During this period, the sector is committed to working with Brazilian government entities and entities which represent rural producers and society to:

a) Prepare and implement a plan that includes an effective mapping and monitoring system for the Amazon biome or that is based on the official map of the corresponding area received from the Federal Government;

b) Develop strategies to encourage and move soy producers to comply with the Brazilian Forest Code;

c) Work together with interested sectors to develop new rules on how to operate in the Amazon biome, collaborating with the Brazilian government and getting them to define, apply and comply with public policies (economic-ecological zoning) regarding land use in this region.

The sector reiterates its repudiation of slave labor, and companies have incorporated into their soybean purchase contracts a clause allowing a breach of contract if it transpires that the seller used labor analogous to slavery.

São Paulo, July 24, 2006.

4.10 yields and pesticides

Yield increase has been one of the main benefits attributed to Roundup Ready soy. However, the kilogram per hectare ratio of soybean has been in decline since 2002, leading one to conclude that RR soy does not have an impact on yield (ABIOVE, 2006a).

It has been reported that under drought conditions, transgenic soybeans suffer higher losses than conventional soybeans. One contributing factor may be that RR soy is not as resistant to heat and drought as conventional soy varieties (New Scientist, 1999). In 2005, Brazil's drought caused a 72% decrease in soybean yields in Rio Grande do Sul, where RR had been widely adopted (IPS, 2005). In 2005, the president of the Rio Grande do Sul seed association announced that crop losses were 25% higher for GM soy than for conventional soy, and the governor of Matto Grosso, responsible for 25% of total national production, announced that the state would not plant GM crops the following year (Polaris Institute, 2005).

"Yields of transgenic soybeans are especially low under drought conditions. Due to pleiotropic effects (stems splitting under high temperatures and water stress), transgenic soybean suffer 25% higher losses than conventional soybean. Seventy-two percent of the yields of transgenic soybeans were lost in the 2004/2005 drought that affected Rio Grande do Sul, and a 95% drop in exports is expected with dramatic economic consequences. Most farmers have already defaulted on 1/3 of government loans."

Altieri and Pengue, 2005.

The other benefit of GM crops constantly claimed by the biotech industry is a reduction in pesticide use. In fact, a study by IBAMA shows that the introduction of GM soy has augmented the use of agrochemicals in Brazil. According to the study, the consumption of glyphosate increased by 95% in the country between 2000 and 2004. In Rio Grande do Sul, where Roundup Ready soy is concentrated, the use of glyphosate was increased by 162%. Over the same period, the consumption of all other herbicides together increased the much smaller amount of 29.8% (IBAMA/DILIQ/DASQ, Informação Técnica, no. 84/05). Additional studies by Embrapa and other foundations have also shown that the continued use of glyphosate leads to an increase in weeds, a key factor stimulating agrochemical use (ASPTA, 2006a,b).

Furthermore, the soybean harvest in 2006 and in previous years shows that the use of agrochemical products cannot be measured on the basis of a single parameter. For example, RR soy is not immune to fungal diseases like rust. Agrochemical sales related to rust treatment have skyrocketed over the past four years, totalling US$1.4 billion dollars. Meanwhile, as spraying increased, local soybean prices declined throughout 2006 and farmers reportedly started to use cheaper and natural low-input methods, including lime and bone meal phosphate, in place of agrochemicals (USDA, 2006e).

TABLE 6 BRAZIL'S LOSSES DUE TO ASIAN RUST (1,000 TONNES AND 1 MILLION US DOLLARS)

	2002/03	2003/04	2004/05	2005/06
Production loss (1,000 t)	3,350	4,590	n/a	1,500
Financial loss	$734	$1,225	n/a	$330
Agrochemical costs	$442	$860	n/a	$1,420
Total financial loss	$1,176.40	$2,085	n/a	$1,750

Source: *USDA, 2006e.*

4.11 future perspectives for soybean production

The Brazilian Association for Vegetable Oil Industries (ABIOVE) envisions a 70% increase in soybean production over the next 14 years, from 62 million tonnes to 105 million tonnes. The association aims to achieve this through a 37% increase in land use by 2020 (ABIOVE, 2005).

It looks like biodiesel will be an important contribution to this planned expansion in soybean production. In 2006, Brazilian producers Ampa and Aprosoja announced their plan for producing 100 million liters of biodiesel from soy and cottonseed. Major companies like Bunge and the Maggi Group will cooperate in this project (USDA, 2006e).

The push for GM soy in Brazil will meanwhile continue unabated. According to several USDA reports (which are not however backed by empirical evidence), production levels would have been higher if biotech varieties had been used (USDA, 2006n). This kind of general affirmation by the USDA is strange given the current crisis, in which the livelihood of hundreds of thousands of farmers is severely impacted.

usda analysis of the brazilian situation

"Due to large stocks and continuing big production in the US, the international market is bearish on soybeans. The combination of low international prices, rising costs of inputs and transportation, and the strong Real that cheapens exports, continues to cut away at farmers´ profit margins. It would appear that farmers in Brazil have still not reached the end of the tunnel, and for the most part, have seriously depleted their resources."

Source: *USDA, 2006e.*

5 soybeans in paraguay

In Paraguay, soybeans occupy more than 25% of all agricultural land (Altieri and Pengue, 2005). Paraguay is the fourth largest soybean exporter in the world, producing about 2% of total global soy (USDA, 2005f). The country houses some 43,000 soy producers, and soybeans covered around 2 million hectares of land in 2005-06 (Base-IS, 2006).

Over 60% of the total Paraguayan soybean production is exported. Exports of soybean from Paraguay are forecasted to increase to 3.1 million tonnes in 2006, particularly due to increased demand from the Argentinian crushing industry (USDA, 2006i). Brazil, which purchases around 47% of the overall production, is the main destination for Paraguayan grains, followed by the EU with 23% and other Latin American countries with 14%.

5.1 the introduction of rr soy in paraguay

Four Roundup Ready soy varieties were approved in Paraguay in 2004 (Monsanto, 2004b; Reuters, 2004b). The authorization was carried out unilaterally by the Minister of Agriculture, Antonio Ibañez. Alfredo Molinas, the Minister of Environment, complained about the process. In his opinion "Monsanto should invest the biggest possible quantity of resources in health and environmental issues to prevent the risks that our country assumes" (SEAM, 2006).

Monsanto welcomed the Paraguayan government's decision to use GM soy as a "milestone for agriculture in Paraguay". Until 2004, GM crops were not permitted in the country (USDA, 2000), but, according to Reuters, around half of the soy cultivated in Paraguay had been genetically modified for years due to smuggling from Argentina. Paraguay imports around 80% of its seeds from Argentina, and the rest from Brazil.

In 2006, an estimated 80% of the two million hectares cultivated in Paraguay were GM varieties.

5.2 rr soy production in crisis

In 2004, over one million hectares of land in Paraguay were cultivated with Roundup Ready soy, 90% of which used no-till systems. A similar technological package to the one promoted by the Argentinian Association of No-till Producers (AAPRESID) was introduced in Paraguay.

Coincidentally, the year that RR soy was legalized was also the start of three consecutive poor years for agricultural production due to drought. The forecast for the 2005/06 season was 4.04 metric tonnes planted on 2 million hectares, down from an expected 5.5 million hectares. This means a projected loss in export earnings of some US$300 million (USDA, 2006i).

Higher yields were also expected from the soybean: an increase of up to 2700 kilograms per hectare from the 2000 kilograms per hectare obtained in 2004-05. Again, however, productivity was very low in 2006. In the areas of Itapúa, Alto Paraná, Canindeyú and parts of Caaguazú, only around 800 kilograms per hectare were produced despite estimates of 2200 kilograms per hectare (Base-IS, 2006). Some municipalities, like Nueva Esperanza in the Department of Canindeyú, were declared a "state of emergency" in January due to the losses suffered in agricultural production. The USDA also recognizes how difficult the situation is in Paraguay, and how challenging the cultivation of RR varieties has been there (USDA, 2006i).

Genetically modified soy varieties have been more affected by drought than conventional varieties as they are not adapted to Paraguayan weather (Base-IS, 2006). Officers from the Paraguayan Environmental Ministry detected bigger losses in the areas where a particular variety, RR 4610, was planted. In the departments of Canindey and Alto Paraná, some 70% of GM soy production was lost in the 2005/06 growing season. Members of the Paraguayan Farming Coordination manifested their unhappiness with the RR varieties that were unable to resist shorts periods of drought (SEAM, 2006).

three the 'gm soy republics' of south america

"The conclusions of a monitoring study undertaken by the Paraguayan Biosafety Plan under the UN Environment Program's Global Environment Facility (GEF)about the behavior of soy (glycine max) indicated that in the colonias of Obligado and Pirapó in the department of Itapúa, the varieties were highly sensitive to drought, and there was a high risk of losing between 60 and 90% of the production.

The technicians of the Environmental Ministry that undertook the study indicated in the report given to [Environmental Minister] Alfredo Molinas found that the soy produced in the colonias Unidas and Pirapó (GM variety 4910 of Argentinian origin) is highly sensitive to the current drought period. Its estimated yield will likely average around 1,000 kilograms per hectare, with a maximum of 1,500 kilograms per hectare. The lack of rain in the first months of the year implied a great loss for the producers involved in soy cultivation, particularly that variety. The same situation was observed by Minister Molinas in the departments of Alto Paraná and Canindeyú."

Source: *Paraguayan Environment Ministry, 2006.*

"Grow-out of Paraguayan RR varieties was affected again this year due to dryness. Producers will be forced to either plant non-RR Paraguayan varieties, or risk planting Argentine or Brazilian RR varieties. Since these varieties are not suited to the Paraguayan climate or growing seasons, they may not reach their potential yields if faced with adverse weather conditions."

Source: *USDA, 2006i.*

5.3 the push for royalties in paraguay

A similar model to Monsanto's Brazilian system of double royalty payments appears to have also been introduced in Paraguay. According to Dow Jones in October of 2004, soy farmers, seed producers, co-operatives and exporters agreed to pay a royalty of US$3 per metric tonne to Monsanto for the 2004-2005 season, and this rate will be increased over a five-year period to eventually reach US$6 per metric tonne (Dow Jones, 2004). In addition, according to a US Department of Agriculture report, an agreement was reached between Monsanto and farm lobby groups in March 2004 to pay $3.22 per bag of seed sowed in the 2004/05 crop year (USDA, 2005f). Monsanto has committed a portion of these fees to research and germplasm improvement in Paraguay.

Ultimately, echoing the Brazilian situation, and in light of the critical plight of the soy sector caused by drought, Monsanto Paraguay was forced to reduce its royalty claims towards soy producers from February 2006 onwards (Grazzini, 2006).

"After various meetings and hard negotiations with the producer associations, Monsanto announced that it will significantly reduce royalties for the early soy harvest. This harvest represents around 55% of the area planted this season, and around 30% of the total soy to be exported. The royalties charged will be US$1.30 per tonne; the remaining soy to be exported (70%) will be charged US$3.22 per tonne as determined in July 2005."

Source: *Grazzini, Licensing and Technology Manager of Monsanto in South America, 2006.*

5.4 environmental and socio-economic impacts

Half of the population of Paraguay lives in poverty: in rural areas, poverty levels reach 80%. The land is highly concentrated, with 1.5% of companies controlling 77% of the land. It has been estimated that soy cultivation is responsible for the annual expulsion of 90,000 small farmers from their land (Palau, 2005). Conflict levels between local communities are high, and the resistance against soy growers, most of whom are Brazilian entrepreneurs, has been growing in recent years. During the 2005/06 soy season, some growers called for military presence to protect their harvest (Base-IS, 2006).

In June 2005, for example, press and civil society reports documented the eviction of a peasant community from their land in Tekojoja in the department of Caaguazu. Brazilian soy growers, under protection by police and paramilitary forces, brutally harassed and beat local people despite the presence of lawyers. Meanwhile, paramilitary groups burned homes and leveled them with caterpillar tractors.

Following reports from farmers' organizations, 270 people were evicted, 130 were arrested, all 54 homes were bulldozed, and the community's crops were burned. Two local people were killed by hired gunmen. Church committees and farmers' organizations strongly condemned the incident. Dr. Idalina

Conflicts with soy landowners in Paraguay.

Gómez, coordinator of the church committees, denounced the protection of plantations owned by foreign companies while local farmers were forced from their land (ABC, 2005b). A Paraguayan senator who toured the area, José Nicolás Morínigo, called on the government to take action to redress the situation (Ultima Hora, 2005). The National Institute of Rural Development and Land proclaimed that the eviction in Tekojoja was executed in an irregular manner (ABC, 2005c).

The ecological impacts of Paraguay's soy revolution are extremely negative. The destruction of ecosystems has been very high due to pressure not only from soy production, but also from the coal and timber industries. The Paranense forest, which covered 8 million hectares in 1970, has today been reduced to 1.7 million fragmented pieces. Much of the Atlantic Forest has been cut down. In the 1990s alone, 2 million hectares of forest were destroyed, and the rate of deforestation has reached an estimated 13,866 hectares per month (around 462 hectares per day) over the past three years.

Countless biodiversity is lost every day in the country, and there is a climate of impunity surrounding these destructive environmental actions. In 2005, 4,000 hectares were reported deforested and burned in the department of San Pedro, particularly on the properties of the Brazilian ranchers who have acquired extensive land for soy plantations.

In March 2006, the Environmental Ministry initiated legal complaints against 66 soy producers for violating Forest Law 422 (Base-IS, 2006). Also in 2006, officers from the Environmental Ministry indicted Brazilian soy farmers for deforesting around 300 hectares of indigenous land to cultivate soy in Arroyo Guazú Reserve. In February 2006, the Environmental Ministry was forced to intervene in the case of a Brazilian landowner who was clearing forests to plant soy in violation of forest laws (SEAM, 2006).

In response to these problems, some municipalities, like the Simon Bolivar district in Caaguazú, have issued an ordinance that "will fine the soy producers that degrade the environment with a sanction between 20 and 60 million guaranies and the immediate suspension of its work". The ordinance aims to put the brakes on the progressive march of intensive soy monocultures in the area (Base-IS, 2006).

6. the uruguayan context

Uruguay is a small country located between Brazil and Argentina. It is similar to Argentina in climate, culture, and infrastructure, and in fact many Argentinians view Uruguayan agricultural regions as extensions of their own land. The area covered by soy increased from 77,000 hectares in 2002/03 to over 240,000 hectares in 2004/05. The increase is largely due to the rental and purchase of land by Argentinian businesses for growing soybeans. Approximately 98% of the total area planted with soy is Roundup Ready.

In Uruguay, access to land and other means of production is highly concentrated. This has been aggravated by the neoliberal policies implemented over the past decades, which significantly worsened the situation for family farmers. More than 70% of the country's farms are held by 40,000 Uruguayan farming families. Between 1970 and 2000, more than 20,000 farms disappeared, 12,000 of which were smaller than 50 hectares. This process of forcing farming families from the land has significant implications for the country's food sovereignty and biodiversity. The price of land in Uruguay is less than in Argentina or Brazil, so businesses from these countries can afford to acquire land for forest and soy plantations.

Three GM varieties have been authorized in Uruguay. Monsanto's Roundup Ready soybean followed a similar path as in Argentina: it was approved in 1997, and Roundup soy seeds smuggled from Argentina (where they had been approved the previous year) were detected as early as 1996. Two maize varieties have been approved, one from Monsanto in 2003 and another from Syngenta in 2004. The first variety of maize in particular faced a lot of opposition from Uruguayan civil society, but the case brought against its authorization by organic farmers was thrown out of court.

GM maize was approved in 2003, despite the publication of a technical report by the University of Agronomy which recommended waiting until adequate scientific studies had been carried out at the national level. However, the Risk Assessment Commission based its favorable report on the information provided by Monsanto, and not on studies made within the country.

Monsanto and the soy industry have succeeded in implementing a system to secure royalties for Roundup Ready soy in Uruguay so that extended royalties must be paid for all seed purchases in the country. In addition, the Uruguayan government enacted a decree in December 2004 that authorizes seed companies to sign contracts with farmers for the payment of royalties. Farmers that sign these contracts are renouncing the right - enshrined in the national seeds legislation - to save seeds for their own use.

7. conclusion

Despite repeated claims of benefits, it is clear that most peasants and small-scale farmers, consumers and the environment in South America have not profited from the introduction of GM soybeans.

In Brazil and Paraguay, the soybean sector has been in crisis since 2004, with many farmers highly indebted and unable to profit from soybean production. The introduction of RR soy has done nothing to solve the existing problems of low international prices, drought, and rising costs of inputs and transportation. On the contrary, Monsanto's high-tech soybeans have performed worse than conventional varieties during drought conditions in both southern Brazil and Paraguay, as predicted by US researchers as long ago as 1999. As the New Scientist reported: "...hot climates don't agree with Monsanto's herbicide-resistant soy beans, causing stems to split open and crop losses of up to 40 percent. This could be a serious blow to the St. Louis-based company, which sees Brazil and other Latin American countries as major markets for its soy beans."

Although the livelihoods of many farmers are at risk, thanks in part to lower yields from Monsanto's drought-susceptible soy, the company is pushing hard to increase penetration of RR soy in South America. The company's strategy involves shifting its collection of royalties from payment upon delivery at the granary to a premium on the price of new certified 'legal' seed, which it hopes will end the age-old practice of saving and replanting seeds.

Despite these ambitions, the situation of Brazilian and Paraguayan soy farmers was so critical in 2006 that Monsanto and its agribusiness allies were unable to squeeze them for more royalties, forcing the company to reduce its short-term profit forecasts from Brazil and Paraguay.

In addition, soybean is produced mainly for export feed markets, and not as food for South American people. This consolidation of agribusinesses and concentration of land in rural areas of South America is also contributing to the further erosion of the food sovereignty of local peasant communities.

If small farmers, consumers and the environment are not benefiting from GM crops, then who is? In the case of Argentina, where taxes are high for soybean products, the government's finances have gained from soybean exports. Large-scale farmers have also profited from the convenience effect, although whether they have benefited economically from RR soy in comparison with conventional varieties is not clear. In the case of Brazil and Paraguay, biotech corporations and large agribusiness are driving the further adoption of RR soy in order to profit from royalties on GM seed, expanded soybean area for exports, and of course future expectations of the increased sales that would result from ending the practice of saving, selling and replanting seeds.

RR soy has brought few benefits to people in Brazil and Paraguay due to the above-mentioned factors. Furthermore, if Monsanto and other big seed companies succeed in ending the practice of seed saving, small-scale farmers will face increased dependency on seed suppliers and increased expenses for costly GM seed, and will continue to lose control over their farming systems. It is difficult to see any benefits for small-scale farmers in this potential future.

four the introduction of gm cotton in the world

the introduction of gm cotton in the world

juan lópez villar, friends of the earth international

1. cotton in the world

1.1 introduction

The cotton plant is native to tropical and subtropical regions. The seeds are contained in a boll, and the fibers on the seed constitute cotton lint. Cotton is the raw material for nearly half of all textiles, and its cultivation uses around 2.4% of the world's arable land (Büchlin, 2004).

Cotton is produced in over 60 countries, but 75% of its production, 71% of its area and 70% of its consumption are concentrated in China, India, Pakistan, the US and Uzbekistan (Chaudhry, 2006). In 2006/07, China, India and Pakistan are expected to produce half of the world's output at 13 million tonnes (ICAC, 2006a). Cotton is intensely traded, with around a third of the stocks used for trade (IIED, 2004).

TABLE 1 SELECTED STATISTICS ON COTTON PRODUCTION FOR THE MAJOR COTTON PRODUCING COUNTRIES

	AVERAGE PRODUCTION (kg ha^{-1})	HECTARES CROPPED TO COTTON (x10^{3})	AVERAGE PRODUCTION (Mtonnes)	% OF WORLD PRODUCTION
China	1,100	5,650	6.3	24
USA	960	5,284	5.1	19
India	429	9,500	4.1	16
Pakistan	780	3,200	2.5	10
Brazil	1,150	1,020	1.2	4.5
Uzbekistan[1]	1,300	846	1.1	4.2
West Africa[2]	450	2,400	1.0	3.8
Turkey	1,300	700	0.9	3.4
Greece	1,030	375	0.39	1.5
Australia	1,760	198	0.35	1.3
Syria	1,400	230	0.34	1.3
Egypt	940	300	0.28	1.1
Total		29,703	23.6	90
World production		31,000	26.2[2]	100

[1] Source: AS (2005). [2] Mali, Burkina Faso, Niger, Nigeria, Ivory Coast, Togo, Ghana, Benin, Chad, Cameroon. ***Source:*** *ICAC, season 2004/05.*

1.2 cotton: a farmer's livelihood

There are 20 million farmers who depend entirely on cotton, while another 30 million plant the crop in rotation. China has 14 million cotton farmers; India has 4 million; West Africa has 2 million; Pakistan has 1.3 million; Turkey has 300,000; the US has an estimated 25,000 cotton farmers; and Australia has 1,300. The size of farms vary from region to region: in Africa farms can be as small as 0.5 hectare, while in Australia there are farms with over 15,000 hectares of irrigated production (IIED, 2004).

TABLE 2 COTTON FARMERS IN THE WORLD

COUNTRY	NUMBER
China	14 million
India	4 million
West Africa	2 million
Pakistan	1.3 million
Turkey	300,000
United States	25,000
Australia	1,300

1.3 environmental and social impacts

Water and pesticide use are two of the most serious environmental problems for cotton farmers. Cotton requires large quantities of water for its cultivation and processing; 53% of cotton fields in the world are irrigated. A frequent consequence of intensive cotton planting is soil salinization, which often leads to land abandonment. An estimated that 5 million hectares of arable land have been abandoned due to soil salinization (Kooistra and Termorshuizen, 2006).

Cotton production uses more insecticides than any other single crop, with nearly $2.6 billion worth of pesticides (more than 10% of the world's pesticides and nearly 25% of the world's insecticides) pumped into its cultivation every year. Pesticides used to grow cotton harm people, wildlife and the environment. They can poison farm workers, drift into neighbouring communities, contaminate ground and surface water and kill beneficial insects and soil micro-organisms (PANNA, 2006).

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TABLE 3 PLANT PROTECTION CHEMICAL USE IN THE WORLD (SALES IN MILLION US$)

CHEMICAL GROUP	2000	2001	2002	2003	2004
All crops					
Herbicides	13,796	13,386	12,475	13,348	14,849
Insecticides	8,206	7,744	7,314	7,738	8,635
Fungicides	5,818	5,467	5,450	6,055	7,296
Others	1,364	1,347	1,322	1,374	1,569
Total	29,184	27,944	26,561	28,515	32,349
Cotton					
Herbicides	675	740	685	673	777
Insecticides	1,548	1,467	1,351	1,423	1,618
Fungicides	57	58	57	60	70
Others	282	266	254	252	280
Total	2,562	2,531	2,347	2,408	2,745

Source: *Cropnosis, Limited.*

Labor conditions are another critical concern in cotton farming. The International Labor Organization has confirmed that certain plantations and smallholder regions use forced or bonded labor in the fields (Usher, 2006). A recent report from the Environmental Justice Foundation detailed the use of forced child labor in Uzbekistan, the second largest exporter of cotton in the world with annual sales of over 800,000 tonnes. In this region, the farmers themselves receive little profit from cotton sales, which are mostly appropriated by the country's elite (Environmental Justice Foundation, 2005).

environmental violations caused by cotton farming in uzbekistan

Along with serious human rights violations, Uzbekistan faces an environmental catastrophe of astonishing proportions. In order to irrigate its 1.47 million hectares of cultivated cotton, Uzbekistan's regime has all but emptied the Aral Sea. Once the world's fourth largest body of water, the Aral is now reduced to just 15% of its former volume. Appalling mismanagement has led to the disappearance of the sea's 24 species of native fish, the drying out of associated wetlands, and the creation of tens of thousands of environmental refugees: the former dependents of the Aral Sea's ecosystem.

1.4 genetically modified cotton in the world

Nine countries allow GM cotton cultivation: Argentina, Australia, China, Colombia, India, Indonesia, Mexico, South Africa and the US, representing around 59% of the world's cotton fields (ICAC, 2004a). In 2004/05, it was estimated that around 24% of the world's cotton area had been planted with GM cotton varieties (ICAC, 2005a).

In recent years, the biotech industry has portrayed genetically modified varieties - notably insect-resistant (Bt) and herbicide-tolerant (HT) cotton - as a key tool for improving farmers' livelihoods by increasing yields and lowering pesticide use. The International Service for the Acquisition of Agri-biotech Applications (ISAAA) claims that the use of biotech crops has improved the livelihoods of 7.7 million poor subsistence farmers, including 6.4 million cotton farmers in China and 1 million in India (James, 2005). In those countries, cotton is the main authorized GM crop, so the benefits claimed refer mainly to cotton production. But are these figures and claims real?

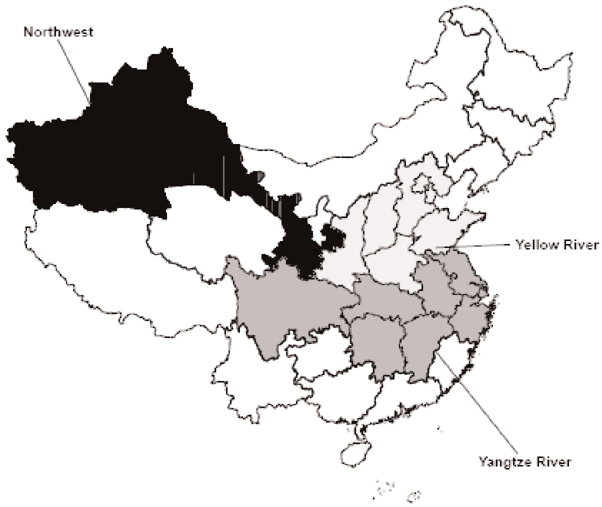
Most of the available literature concentrates on the technology's benefits; unfortunately the negative aspects have not been properly covered in scientific publications, as recognized by the International Cotton Advisory Committee (ICAC, 2005a). This chapter will provide an overview of cotton production around the world, balancing the claimed benefits of GM crop production with its reported negative impacts.

2. cotton in asia

2.1 china, the largest producer in the world

China is the world's largest cotton producer, and cultivation of the crop constitutes a key economic activity in the country. In 2005/06, China planted over 5 million hectares and produced an estimated area of 29 million bales (USDA, 2006c). China also has the largest number of cotton farmers in the world, with an estimated 14 million (IIESD).

FIGURE 1 PRIMARY COTTON-PRODUCING REGIONS IN CHINA



Source: *Economic Research Service, USDA*

2.1.1 the performance of bt cotton in china

Chinese scientists began research on Bt cotton at the end of the 1980s, and licensed the first variety - NewCot 33B - in 1997, imported from Monsanto by the Jidai Cotton Seed Company. In 1998, eight Bt cotton varieties were developed and licensed, four of them created by the Cotton Research Institute of the Chinese Academy of Agricultural Sciences (Zhang and Wang, 2001).

The number of Bt cotton farmers in China is estimated to lie between 5 and 6.5 million; Huang calculated between 4.7 and 5.1 million in 2001 (Huang et al, 2002). Recent reports from Cornell University estimated the number at more than 5 million (Cornell University, 2006), and ISAAA figured that there were 6.5 million small farmers benefiting from Bt cotton in China in 2005 (James, 2005).

The costs of cotton production in China rose at the end of the 1990s, and it was expected that they would decline with the adoption of Bt cotton (Fang and Babcock, 2003). The first variety was taken up very rapidly after its license in 1997, and several studies from the first years of planting reported higher net returns, yields and pesticide reduction (Huang et al., 2002, 2003; Zhang and Wang, 2001).

However, according to a recent study by Cornell University, those early positive trends are now reversing. The study, carried out on a few hundred farmers in five Chinese provinces, showed that in 2004 the net revenue of Bt farmers was significantly lower than that of non-Bt farmers. This is in stark contrast to the early years of cultivation, when it was estimated in for example 2001/01 that the net revenue per hectare was $121 more for Bt cotton than for conventional cotton. A suggested reason for the 2004 reversal was the emergence of secondary pests such as mirids, and the need for Bt cotton farmers to spray 15-20 times more than they previously had in order to kill them. In short, the cost of the extra pesticides to combat the outbreak offset the farmers' savings (Wang and Pinstrup, 2006).

"... The majority of Bt farmers spend more to combat the secondary pest than non-Bt farmers. In 2004, Bt farmers spent an average of $16.01 per hectare on secondary pest control compared to $5.7 per hectare for non-Bt farmers.

Source: *Wang and Pinstrup, 2006.*

In terms of the pesticide reduction benefits of GM cotton, a 2005 study published in the International Journal of Agricultural Sustainability revealed that Chinese Bt cotton farmers continue to use high levels of pesticides. Data collected over one season in 2002 in Linquing County, Shandong Province showed that 150 farmers sprayed high amounts of chemical insecticides, 40% of which were extremely or highly hazardous. While questions remain about the conclusions of that study, the authors believe that the results suggest that the economic benefits of Bt cotton in developing countries are more limited than other research has shown (Pemsl et al., 2005).

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"‥ [O]ur results suggest that the economic benefits of Bt cotton in developing countries could be more limited than concluded in previous papers. As revealed by this study, the reasons are that there are some fundamental problems with the introduction of the Bt cotton varieties in China, and perhaps in other developing countries too. First, lack of standards and unreliable quality limit the potential benefits of all input-based technologies including Bt seeds and pesticides. Second, there is a problem of collecting and using pesticide data from small-scale farmers in developing countries as a base for estimating pesticide reduction benefits from Bt crops. Third, the economics of Bt varieties, which are nothing but a new pest control option for some lepidopterous pests, crucially depend on control effectiveness. [...] Fourth, given the imperfections in the markets for agricultural inputs and the sometimes dysfunctional agricultural extension system in China, the effect of Bt crops to reduce the use of toxic chemicals in a sustainable way and therefore realize the potential economic, health and environmental benefits are limited.... Fifth, and perhaps equally important, there is a knowledge issue with the use of Bt varieties by small-scale farmers in developing countries."

Source: *Pemsl et al., 2005.*

2.1.2 chinese experience contradicts isaaa claims

The Cornell University assessment contrasts with the data presented by ISAAA in 2005, which claimed that 6.4 million Chinese farmers benefited from Bt cotton (James, 2005), a drop from its 2004 claim of 7 million (James, 2004). The appearance of secondary pests should not be a surprise, as the use of Bt technology indirectly creates a safer environment for the growth of non-bollworm pests. Entomologists have suggested that it takes between five to ten years for such a secondary pest population to grow to a level at which it poses a significant economic threat. The Cornell study authors recognized that if secondary pests are not adequately taken into consideration, new technologies like Bt cotton could "only serve to exacerbate problems associated with poverty and scarcity" (Wang and Pinstrup, 2006).

One proposed solution is to invest in educating farmers to set aside refuges, which will reduce the threat of the secondary pests. It is argued that the profits lost by creating refuges could be compensated by substantial savings on pesticides: "Such education is particularly necessary in developing countries where Bt technology may be a particularly opaque mechanism" (Wang and Pinstrup, 2006). Pemsl et al. conclude that a lack of enabling institutions and adequate farmer knowledge can limit the performance of Bt cotton for small-scale producers (Pemsl et al., 2006). These aspects raise a critical question about the rapid pace of adoption of this technology. If longer time for preparation for handling was needed, why then were the new GM varieties rushed so quickly into commercialization? Can small farmers in developing countries set aside land for refuges when their farms are already so small? And why were these questions not considered before the Bt cotton was approved?

2.2 india

2.2.1 cotton farmers trapped in a cycle of poverty and debt

Agriculture plays a key role in the Indian economy, with around 70% of the country's population living in rural areas (Indian Agricultural Census). In recent years, India has been submerged in a widespread agrarian crisis (Mishra, 2006). According to the Indian Ministry of Agriculture, small-scale Indian farmers have faced hard times due to a combination of rising input prices, falling output prices, and frequent crop failure caused by unfavorable weather conditions. This critical situation has seen the downwards spiral of farmers' real income, and as a result the majority of small farmers "seem to be badly trapped in poverty and indebtedness" (Indian Ministry of Agriculture, 2006a).

Cotton is an important commercial crop for India, with some 9.5 million hectares of land currently under cultivation (Indian Ministry of Agriculture, 2006c). The country ranks as the third largest global cotton producer after China and the United States.

The major cotton producing states in India are Maharashtra, with around 34% of the total area, followed by Gujarat (around 20%), and Andhra Pradesh (around 11%). The combined area cultivated in these three states is approximately six million hectares per year, and this area is cultivated by millions of small-scale farmers. The agrarian crisis is particularly felt in the cotton growing regions of Andhra Pradesh, Karnataka and Maharashtra, and it "has precipitated a spate of suicide death among farmers" (Mishra, 2006). In Maharashtra, the main cotton state and the second-largest state in terms of population, "the production is so unremunerative that a large number of farmers' suicides have been reported in recent years in this area" (Mishra and Panda, 2006).

FIGURE 3 **MAP OF COTTON GROWING STATES IN INDIA**

Source: *Kambhampati, U., Morse, S., Bennett, R., and Ismael, Y., 2005.*

2.2.2 the introduction of gm cotton in india

ISAAA considers India as one of the world's largest biotech countries, with over a million hectares of GM cotton estimated in 2005 (James, 2005). A UN Food and Agriculture Organization study from 2004 featured India as one of the developing country success stories for Bt cotton, as both higher yields and lower pesticide use were achieved (FAO, 2004). However, one has to wonder whether the reality in the field corresponds to the claims.

Monsanto catalyzed the first releases of GM seeds in India. Field trials with Bt cotton started when Mahyco, Monsanto's Indian subsidiary, imported 100 grams of Bt cotton seed in 1995. This was controversial, as permission had been obtained from the Department of Biotech under the Ministry of Science and Technology, but not from the Ministry of Environment as required (Center for Sustainable Agriculture, 2005). Three years later, in 1998, Monsanto began open field trials on approximately 100 hectares nationwide. These trials were undertaken in great secrecy, and in some cases even the farmers on whose fields they were being carried out were not aware that the varieties grown were genetically modified. Adequate biosafety mechanisms were not in place (Navdanya), and many irregularities were identified (Bharathan, 2000).

In 2001, the Indian Genetic Engineering Approval Committee (GEAC) verified illegal contamination with Bt cotton in Gujarat, and ordered the uprooting and burning of the entire crop, including seed production plots and harvested seeds (Parvathi, 2001). The company involved was called Navbharat Seeds, but the origin of the Bt in the Navbharat 151 cotton variety is to this day unknown (Center for Sustainable Agriculture, 2005). Bt cotton was authorized a few months later, in March 2002, following the 'first contaminate, then legalize' pattern occurring in other countries. A common argument given for the approval was that there was no reason to deny permission to Monsanto-Mahyco GM varieties when there was so much illegal Bt cotton growing already.

2.2.3 bt cotton failures

Mahyco was authorized to release genetically modified cotton over a three-year period between April 2002 and March 2005 (Qayum and Sakkhari, 2004). In March 2002, GEAC allowed the planting of the first GM crop in India in six Indian states. This GM cotton was the product of a Mahyco-Monsanto venture for three hybrid varieties: Mech- 12, Mech-162 and Mech-184. The GEAC decision was driven by the promised economics of Bt cotton, that "the yield would be higher and would fetch 10,000 Rupees (US$207) more per hectare for the farmer than the traditional variety of cotton" (The Hindu, 2002).

The company defined Bt cotton as environmentally safe and economically beneficial, as it would reduce pesticide use and cultivation costs and result in increased yields (Qayum and Sakkhari, 2004). These stated benefits encouraged many farmers to buy the seed, hoping to save money despite the fact that the Bt cotton seeds cost more than conventional ones.

Immediately after the first planting season, Mahyco-Monsanto claimed success regarding the use of its Bt cotton technology on the basis that it "reduced pesticide use by 65-70 percent and, consequently, led to yield gains of 30% and an extra income of 7,000 Rupees (US$145) per acre (17,500 Rupees or US$363 per hectare) in the southern states". (Krishnaukumar, 2003). Mahyco's survey of Bt cotton's performance in the six states showed a substantial increase in yield, a significant decrease in the number of insecticide sprays (the overall average indicated a yield increase of 8.1 quintals of cotton and a reduction of 1.93 sprays), and an average additional income of more than 18,000 Rupees (US$373) per hectare for Bt in comparison with non-Bt cotton (Barwale et al., 2004).

These conclusions and data, provided by Monsanto, were the basis for hyping the success of Bt cotton in an article in the reputed scientific journal Science, in which academics Qaim and Zilberman concluded that "the technology substantially reduces pest damage and increases yields" (Qaim and Zilberman, 2003). This published paper is the basis for the conclusion of the 2004 UN Food and Agriculture Organization (FAO) study that Bt cotton in India is an example of the success of GM technology. In short, the FAO came to these conclusions on the basis of the very limited analysis carried out in the Qaim and Zilberman article, which was based only on 2001 field trial data provided by Monsanto-Mahyco.

However, the claims of Monsanto-Mahyco, spun for the media and treated as official by organizations such as the UN FAO, ISAAA and others, contrasted heavily with other information coming from the field. The findings of state governments, farmers' organizations, non-governmental organizations and scientists revealed a different scenario (Krishnaukumar, 2003; The Hindu, 2002; The Hindu Business Line, 2003a,b). Negative reports and complaints from farmers started arriving shortly after the planting season, initially from Andhra Pradesh and Madhya Pradesh, but eventually from all states (Center for Sustainable Agriculture, 2005). The conclusions were similar: resistance to bollworm, the major cotton pest that the Bt cotton was supposed to repel, was low; yields were poor; and Bt cotton was more susceptible than other popular varieties to attacks by additional pests such as aphids, jassids and white mosquitoes (Krishnaukumar, 2003).

"The average boll weight of Mahyco Bt cotton varieties [...] is very little in comparison with other non-Bt popular hybrids; the staple length of the Bt cotton varieties is also short, and hence it fetches lower prices in market compared with other popular hybrids; the Bt cotton varieties show more susceptibility to wilting under heavy rains compared to other popular varieties."

Source: *Maharashtra State Department of Agriculture, 'Performance of Bt Cotton Cultivation in Maharashtra', 2003.*

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TABLE 4 BT COTTON RESULTS FROM KHARIF[a] 2002 SEASON, JUNE-DECEMBER (YIELD IN QUINTALS[b]).

STATE	NON-BT YIELD	BT YIELD	YIELD INCREASES WITH BT	NON-BT SPRAYS	BT SPRAYS	SPRAY REDUCTION WITH BT	ECONOMIC BENEFIT PER HECTARE[c]
Andhra Pradesh	14.42 (5-25)	20.52 (12.5-32.5)	6.10	4.81 (1-8)	2.08 (0-4)	2.73	Rs.16,747
Gujarat	19.80 (3.7-37.5)	28.35 (10-44)	8.55	3.42 (1-7)	2.09 (0-5)	1.33	Rs.18,430
Karnataka	10.50 (1.3-30)	17.82 (7.5-40)	7.32	2.53 (0-6)	1.00 (0-3)	1.53	Rs.16,170
Madhya Pradesh	15.00 (10-50)	25.82 (35-62.5)	10.82	3.29 (1-9)	0.93 (0-3)	2.36	Rs.24,000
Maharashtra	14.47 (2.5-45)	20.82 (2.5-62.5)	6.35	2.78 (0-7)	0.99 (0-4)	1.79	Rs.14,490
Tamil Nadu[d]	-	-	-	-	-	-	-
TOTAL	13.25	21.35	8.10	3.10	1.17	1.93	Rs.18,130

Note: *All figures given in the table are based on a survey conducted by Mahyco in the six states where Bt cotton seed cotton was sold in the 2002 kharif season.[a] The total sample size was 1,069 farmers. Averages are on weighted average basis. Figures in parentheses represent the range for yield (quintals per hectare) and number of sprays.*

a Kharif refers to a crop that is harvested at the beginning of winter.
b 1 quintal = 100 kg.
c Economic benefit per hectare was calculated on the basis of an average cotton rate of Rs.2,000/q and an average cost of each bollworm complex spray of Rs.1,000/ha.
d Cotton picking still in progress in Tamil Nadu at date of writing.

Source*: Barwale, R.B., Gadwal, V.R., Zehr, U., and Zehr, B., 2004.*

A study from Andhra Pradesh concluded that the net profit for Bt cotton farmers was inferior to that of conventional farmers, and even the state's Minister of Agriculture said in March 2003 that the "overall information is that the farmers have not experienced very positive and encouraging results", and that they should be compensated (Center for Sustainable Agriculture, 2005). The Department of Agriculture of the State of Maharshtra similarly reported that the performance of Bt cotton was no better than that of other popular non-Bt hybrids (Maharashtra State Department of Agriculture, 2003).

Despite the results of this first season, Mahyco-Monsanto did not acknowledge the failure of the crop, nor did the company offer compensation to farmers. On the contrary, they stepped up propaganda and promotional activities for the use of Bt cotton in the following season (Maharashtra State Department of Agriculture, 2003). The director of Mahyco-Monsanto said that the "farmer's performance in six states has been good, prompting us to expand our sales this kharif season" (Center for Sustainable Agriculture, 2005). The company launched media campaigns in which GM seeds were portrayed as highly performing and endowed with magical qualities. It also spread propaganda about the excellent results of Bt cotton in other parts of the world, including the United States and Australia. Free gifts, feasts and per diems were offered to farmers in Monsanto's Bt cotton promotional drive. Intensive marketing through local newspapers, local meetings and television advertisements - some featuring popular actors - appeared in several Indian states (Greenpeace, 2005). The National Commission on Farmers reprimanded the seed company for its "aggressive advertisement" (The Financial Express, 2005f).

The report by Quayum et al. on the second planting season in 2003/2004 also concluded that the performance of Bt cotton in Andhra Pradesh was a failure, with net profits 9% less than profits from non-Bt hybrids. Furthermore, the yield difference between Bt and non-Bt was negligible. The conclusion of the Andhra Pradesh farmers' coalition was that "though Bt cotton was touted with the claim that it would reduce the total cost of cultivation by reducing the number of sprays and thereby the cost of pesticide consumption, it totally failed in fulfilling this promise. It in fact increased the cost of cultivation for all categories of farmers."

Once again, the farmers' results contrasted sharply with the report commissioned by Mahyco-Monsanto on yields, pesticide use, and number of sprayings for Bollworm in the 2003-2004 season. In terms of profits, the Monsanto study claimed a net profit of 7276 Rupees (US$151) per acre for each Bt farmer, but interestingly, kept silent about the profits of non-Bt farmers (Quayum and Sakkhan, 2004, 2005).

Nonetheless, Monsanto India's marketing manager described expectations for the future of Bt cotton as very high in 2004: "The commercialization of Bt cotton is benefiting cotton producers in India. They use less insecticide, have lower costs and have peace of mind. The mills have better quality and cleaner cotton. [...] At present, we saw an increase of 30% in yield, which is equivalent to £1 billion (US$1.4 billion) for India. [...] Our aim is to work with all the cotton seed companies in India and to introduce the Bt gene in most of the important cotton hybrid in India. We are currently working with Mahyco, Rasi, Ankur, and Nuzividu, and aim to release some 20 Bt hybrids" (Kambhampati et al., 2005).

TABLE 5 **ANNUAL PERFORMANCE OF MAHYCO-MONSANTO BT HYBRIDS [MECH BT] AND NON-BT HYBRIDS FROM 2002-03 AND 2004-05**

ECONOMICS OF CULTIVATION OF BT AND NON BT CROPS AND THE % OF EXPENDITURE TO THE TOTAL COST OF CULTIVATION

	2002-03			2003-04			2004-05		
DESCRIPTION (COSTS/ACRE)	MECH BT	NON BT	GAIN WITH BT	MECH BT	NON BT	GAIN WITH BT	MECH BT	NON BT	GAIN WITH BT
Seed cost (Rs/acre)	1600 (15%)	450 (5%)	-1150	1469 (12%)	445 (4%)	-1024	1062 (13%)	505 (5%)	-1097
Pest management (Rs/acre)	2909 (27%)	2971 (31%)	62	2287 (19%)	2608 (23%)	321	2510 (21%)	2717 (26%)	207
Total costs of cultivation (Rs/acre)	10655	9653	-1002	12030	11127	-903	12081	10298	-1783
Net returns (Rs/acre)	-1295	5368	-6663	7650	8401	-751	-252	597	-849
Yield (kg/acre)	450	690	-240	827	800	27	669	635	34

Figures in parentheses denote percentage of the total cost of cultivation.

Source: *Quayum A. and Sakkhari, K., 2005. 'Bt cotton in Andhra Pradesh: A Three Year Assessment.*

That scenario was again challenged following the third year of planting, when similar negative reports were gathered in Andhra Pradesh (Financial Express, 2005a). The Bt cottonseed was over 300% more expensive than non-Bt hybrids, and the yield performance was again poor. The yield for small farmers growing Bt under rainfed conditions was about 535 kilograms in 2005, while the same farmer cultivating non-Bt hybrids under the same conditions harvested 150 kilograms more. Ultimately, the three-year evaluation of Bt cotton planting in Andhra Pradesh showed that non-Bt farmers earned 60% more than Bt farmers.

Protests by angry farmers were reported in early 2005. The farmers' coalition of Andhra Pradesh describes how "in actual fact, in place of profit, Bt cotton, especially the Mahyco Monsanto varieties, brought untold miseries to farmers culminating in violent street protests and the burning of seed outlets in the city of Warangal" (Quayum and Sakkhan, 2005). Hundreds of farmers

demanded compensation for the losses they had incurred with the cultivation of Bollgard Bt cotton (Financial Express, 2005b). In this context, the government of Andhra Pradesh called for Monsanto to compensate the farmers who had incurred losses (Center for Sustainable Agriculture, 2005). This was the origin of a landmark 2005 decision to ban the use of commercialized Bt cotton varieties in some Indian states.

"On at least 25,000 acres, farmers used Mahyco's Bollgard seeds. In many places crops were damaged, even at the flowering stage. Compared to other cotton varieties, Bt yields are hopeless. Realizing that they were cheated again by seed companies, farmers today destroyed seed shops in Warangal and burnt their hoardings. [...] In Warangal District, farmers have lost over ten million rupees. That Mahyco seeds have totally failed is completely true."

Maa TV News, 15 October 2004, quoted in Qayum, A. and Sakkhari, K., 2005.

2.2.4 first commercialized varieties of bt cotton banned

In May 2005, the GEAC refused to renew the licenses for the sale in Andhra Pradesh of the three first-ever GM cottonseed varieties authorized for commercialization in India: Monsanto's Mech-12 Bt, Mech-162 Bt and Mech-184 Bt. These varieties had completed three years of commercial cultivation, and were awaiting renewal of approvals at the beginning of the 2005 season. The reason given was that the varieties had been found ineffective in controlling pests in Andhra Pradesh (AP, 2005b; Financial Express, 2005c; The Hindu Business Line, 2005). The decision was taken after adverse reports were received from about 20 farmers' organizations in the region; the organizations further demanded that the unauthorized Bt cotton be seized before the sowing season. The Andhra Pradesh government also called in the High Court regarding compensation to farmers. As State Agriculture Minister N. Raghuveera Reddy said: "If they do not pay the compensation amount before this cotton season, we will not hesitate to cancel their license" (The Economic Times, 2006a).

"We want the company to pay compensation of Rs 3,000 per acre to the farmers. During the kharif summer crop last year, the Bt cottonseeds had failed in 25,000 acres in Warangal district. We think the company is accountable for this as it supplied poor quality seeds."

Andhra Pradesh Agriculture Minister N. Raghuveera Reddy in The Economic Times, 2006c.

The GEAC furthermore disallowed the commercial cultivation of Mech- 12 Bt in all of southern India after receiving adverse reports about its performance over the previous three years. Mech-12 cultivation was limited to Maharashtra, Gujarat and Madhya Pradesh. Mech-162 Bt and Mech-184 Bt could still cultivated in the other Indian states (Financial Express, 2005c,d).

"This decision was taken on receiving adverse reports from about 20 farmers' organizations. The Andhra Pradesh government had given adverse reports on the performance of Bt cotton, while other states like Karnataka, Tamil Nadu, Maharashtra and Madhya Pradesh have sent mixed reports. The Gujarat government has not sent any reports so far."

Source: *Senior GEAC member in India's Finance Express, 2005c.*

Nonetheless, the Indian government continued to allow the commercial cultivation of four new Bt cotton hybrids: MRC-6322 Bt and MRC-6918 Bt developed by Mahyco, and RCH-20 Bt and RCH-368 Bt developed by Rasi Seed. In central India, the GEAC approved five new Bt cotton hybrids for commercial cultivation: RCH-144 Bt and RCH-118 Bt developed by Rasi Seed, MRC-6301 Bt developed by Mahyco, and Ankur-681 and Ankur-09 developed by Ankur Seeds. The very same GEAC members who had banned the first varieties in Andhra Pradesh gave these approvals, despite the fact that the reports sent by four governments were mixed and no report was sent by the fifth government (Financial Express, 2005c).

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Meanwhile, reports from the 2004-2005 kharif confirmed similar problems. The Maharashtra government observed that Bt cotton suffered more from sucking pests than non-Bt cotton, and organic cotton farmers had higher yields than Bt cotton farmers. Similar findings were also observed in some districts of Andhra Pradesh, while a significant percentage of Bt seeds failed to germinate in Tamil Nadu (The Hindu, 2005; MEC 2005a,b,c). In 2006, despite the increased adoption of new hybrid Bt cotton varieties, new episodes of failure occurred in Andhra Pradesh. In several villages in the Warangal district, the Bt cotton planted on over 40,000 hectares suffered huge losses due to wilting (APCID and WAGE, 2006).

2.2.5 bt cotton prices end up in the supreme court

In 2006, disputes over the price of Bt cotton arose in several Indian states. In January, the Andhra Pradesh government asked the Monopolies and Restrictive Trade Practices Commission (MRTPC) to stop Monsanto from imposing a royalty of Rs 1250 on each 450 gram packet of Bt cotton (The Times of India, 2006a). In April 2006, the MRTPC recommended action against the company for its "restrictive trade practices", and directed it to charge “reasonable prices” for the seeds (The Economic Times, 2006b). Subsequently, the Tamil Nadu and Karnataka governments directed Monsanto-Mahyco not to charge more than Rs 750 per 450 gram packet, but the company filed petitions against both state governments in the Supreme Court. Monsanto-Mahyco continues to argue that the state governments do not have the power to fix the price of seeds (Financial Express, 2006a).

In May 2006, the MRTPC said that that the company had indulged in restrictive trade practices, stating that: "by temporary injunction the respondent (Mahyco Monsanto Biotech India Ltd.) is directed during the pendency of this case not to charge trait value of Rs 900 for a packet of 450 grams of Bt cotton seed and to fix the reasonable trait value considering the trait value that is being charged by its parent company in neighbouring countries like China" (The Hindu Business Line, 2006b). At the Supreme Court in June, the Andhra Pradesh government demanded that Monsanto not charge more than Rs 750 on a 450 gram pack, and Monsanto chose not to dispute this (The Hindu, 2006a). Nevertheless, the company did not respect these prices, and the Andhra Pradesh government filed an application for contempt proceedings on 26 June 2006 in connection with Monsanto’s violation of the ordered seed price reduction (The Hindu, 2006b).

"The Director General of Investigation and Registration - the Monopolies and Restrictive Trade Practices Commission’s investigative arm - has reported that Mahyco Monsanto indulged in restrictive and monopolistic trade practices. The company manipulated the price and charged a very high price for the BT Cotton seed."

Source: *BK Rathi, Chairman, Monopolies and Restrictive Trade Practices Commission, on NDTV, 2006.*

In June, agricultural ministers and officials of seven cotton growing states (Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Tamil Nadu and West Bengal) adopted a unanimous resolution to form a joint party in a legal battle against Monsanto before the MRTPC and the Supreme Court of India (USDA, 2006w). As of December 2006, the case was still pending.

2.2.6 aggressive penetration of gm cotton continues in india

India is a strategic market for agribusiness dealing with cottonseed. Monsanto estimates the Indian market potential for GM cottonseed at between 8 and 12 million hectares by 2010 (Monsanto, 2006i). Full adoption of GM cotton would be very profitable for companies like Monsanto, which aims to increase GM cotton penetration both through its own new seeds and through licensing the trait technology via local companies.

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India.

In addition to the private sector, US government agencies are also engaged in promoting biotech commercialization in India. The US Department of Agriculture, USAID and the US State Department have actively coordinated various biotechnology activities in India. Since 2003, numerous conferences and two speaker's tours with US and Indian regulators have been organized in order to lay the ground for the penetration of GM crops. Agencies like USAID-India are "closely working with various public and private sector research organizations to develop and commercialize biotech crops" (USDA, 2005n).

Bt cotton has been promoted to Indian officials as a way to improve the productivity of the cotton sector. The Indian Ministry of Agriculture has identified low yields and poor quality as two of the challenges faced by the Indian cotton industry, and thinks that "Bt cotton seems to hold a lot of promise" (Indian Ministry of Agriculture, 2006a). The link between increased yield and improved quality of cotton is paradoxical given the fact that Bt cotton technology is unable to improve either the yield nor the quality of cotton. As was detailed in chapter two, "currently available GM crops do not increase the yield potential of a hybrid variety".

However, the number of GM cotton varieties available to Indian cotton farmers has increased in the past year thanks to Monsanto and other local seed companies.

TABLE 6 **BT COTTON HYBRIDS APPROVED TO DATE**

	2002	2003	2004	2005	2006
NORTH ZONE (23%)*				**6 HYBRIDS**	**7 HYBRIDS**
HARYANA				RCH 134, RCH 317	MRC 6026, MRC 6029
PUNJAB				MRC 6304	NCS-913, NCS-138
RAJASTHAN				MRC 6301, Ankur 651, Ankur 2534	NCEH-6RCH-308RCH-314
CENTRAL ZONE (58%)	**3 HYB**	**3 HYB**	**4 HYB**	**12 HYBRIDS**	**11 HYBRIDS**
GUJARAT	Mech 12	Mech 12	Mech 12	Mech 12, Mech 162,	ACH-33-1, ACH 155-1,
MADHYA PRADESH	Mech 162	Mech 162	Mech 162	Mech 184, RCH 2,	Brahma Bt, GK 205,
MAHARASHTRA	Mech 184	Mech 184	Mech 184	RCH 144, Ankur 09, Ankur 651,	RCH 377, Tulasi-4, VICH-5
			RCH2	MRC 6301, NCS-145 Bunny,	VICH-9, VICH-111
				NCS-207 Malilka	
SOUTH ZONE (19%)	**3 HYB**0.63	**3 HYB**	**4 HYB**	**9 HYBRIDS**	**15 HYBRIDS**
ANDHRA PRADESH	Mech 12	Mech 12	Mech 12	Mech 162, Mech 184,	ACH-33-1, Brahma Bt, GK
KARNATAKA	Mech 162	Mech 162	Mech 162	RCH 2,	207, GK 209, KDCHH-9632,
TAMIL NADU	Mech 184	Mech 184	Mech 184	RCH 20, RCH 368, MRC 6322,	NCS-913, NCEH-3, RPCH-2270,
	-0.35		RCH2	MRC 6918, NCS-145 Bunny,	PRCH-102, PRCH-103, RCH 111,
				NCS-207 Malilka	RCH-371, RCHB-708,
					VICH-5, VICH-9
TOTAL	**3**	**3**	**4**	**20**	**25**

** Figures given in percentage denote the contribution of each zone in the development of hybrids*

Source: *ISAAA via Monsanto India*

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2.2.7 is bt cotton improving the livelihoods of indian cotton farmers?

In a 2006 report, the Mumbai-based Indira Gandhi Institute of Development Research pinpointed the acute rural crisis in cotton growing areas that has led to many farmers' suicides: "In recent years, a larger agrarian crisis, particularly in cotton growing regions of Andhra Pradesh, Karnataka and Maharashtra, has precipitated a spate of suicide deaths among farmers."

The reasons for the indebtedness and poverty of small cotton farmer communities are manifold, but in the last couple of years the main factors have been prices, high input costs, and unfavorable weather. Cotton farmers are still highly indebted and default in credits, and the costs of cultivation do not seem to have been reduced in recent years (Hardikar, 2006). In Maharashtra, it is reported that cotton faces substantial competition from subsidized cotton from the US. Thus, despite increased output, "prices for different grades of cotton have fallen drastically" and cotton is becoming unprofitable for small farmers (Zora, 2006a). It has also been concluded that "when the farmer is exposed to the global market, there is no mechanism that will guard him/her against price volatility" (Mishra, 2006b).

Lack of water and irrigation facilities are also major problems for cotton farmers in the region of Vidharba (Maharashtra), also known as the cotton belt. A bad harvest due to unfavorable weather is one of the reasons given for the suicide of several hundreds farmers in the past year. As a 2006 BBC report explained: "Sixty percent of India's land is not irrigated. A bad monsoon means a bad harvest -and more debt for these farmers" (BBC, 2006).

> "Hundreds of farmers have killed themselves in the Vidharba region in the last year because of drought-related debt. It's a vicious cycle. Farmers borrow money to buy seeds in the hopes of a good monsoon. But erratic rains, and lack of information about when the rains are coming, make for a poor harvest."
>
> ***Source:*** *BBC, 2006.*

Although Bt cotton has been often presented to farmers as a magic bullet to improve their livelihoods, it can do little to address the key challenges of Indian cotton farming. A clear example of this is provided in this investigative report by the New York Times that tells the story of a small cotton farmer who committed suicide in 2006:

"The farmer, Anil Kondba Shende, 31, left behind a wife and two small sons, debts that his family knew about only vaguely, and a soggy, ruined 3.5 acre patch of cotton plants that had been his only source of income. This year, waiting for a tardy monsoon, Mr. Shende sowed his fields three times with the genetically modified seeds made by Monsanto. Two batches of seed went to waste because the monsoon was late. When the rains finally arrived, they came down so hard that they flooded Mr. Shende's low-lying field and destroyed his third and final batch. Mr. Shende shouldered at least four debts at the time of his death: one from a bank, two procured on his behalf by his sisters and one from a local moneylender. The night before his suicide, he borrowed one last time. From a fellow villager, he took the equivalent of $9, roughly the cost of a one-liter bottle of pesticide, which he used to take his life" (The New York Times, 2006c).

Are there solutions that will improve the livelihoods of small cotton farmers? While seed agribusinesses are putting great effort into pushing technological answers like Bt cotton, the truth is that the main agrarian problems do not lie in technological deficiencies. The challenges faced by Indian cotton need a holistic set of solutions, most of which have little to do with technology fixes. In his 2006 study, Srijit Mishra of the Indira Gandhi Institute proposes several policy interventions that would help to tackle the agrarian crisis including the revitalization of the rural financial market; making cooperative credit societies accountable; the reorganization of regional rural banks; the regulation of private moneylenders; strategies to increase irrigation potential; the diversification of cropping pattern; the promotion of organic farming; and so on (Mishra, 2006a).

Despite claims by companies of reductions in input costs, the introduction of Bt cotton does not seem to have been accompanied by a decrease in pesticide use. According to Mr. Deepesh Shroff of Excel Crop Care, a leading Indian pesticide manufacturer, the increase in Bt cotton plantations has not meant a decrease in overall pesticide use (The Hindu Business Line, 2006c).

More sustainable alternatives exist. Mishra encourages the introduction of organic farming, which would reduce the costs associated with pesticides and fertilizers, and would also decrease the availability of pesticides for suicidal farmers (Mishra, 2006a).

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Farmers in South Sulawesi, Indonesia burning GM cotton in September 2001.

2.2.8 who benefits from bt cotton in india?

On its website, Monsanto affirms that Bt cotton has allowed Indian farmers to reduce their spending on pesticides and to increase their profits by more than 60% per acre. ISAAA assumes that Bt cotton adoption equals direct benefits for Indian farmers, and a states in a 2005 report that one million subsistence farmers in India are benefiting from Bt cotton (James, 2005). No hint of the problems, difficulties or failures related to Bt cotton in India is to be found on either Monsanto or ISAAA's website.

This chapter has shown that many farmers who planted Bt cotton have suffered losses. Success cannot be measured by the fast penetration of GM cotton or high levels of adoption by farmers; the true story lies in the numerous failures, strong opposition, and ongoing problems with price setting in many states. The discontinuation of the first three varieties of Bt cotton tested in Andhra Pradesh is proof of their negative performance and their inability to benefit farmers there.

Not only the failures, but low prices and continuing problems with cotton cultivation linked to weather factors, pests and diseases like wilting all raise serious doubts about whether Bt cotton can sustain the livelihoods of Indian farmers. Until the complex structural issues linked with cotton production are addressed, a Bt cotton fix will not be sufficient to lift small Indian cotton farmers from the cycle of poverty and indebtness.

The progression of Bt cotton in India has been more the result of an aggressive lobby and media campaign offering false promises than of the genuinely adequate performance of a technology that benefits farmers. The marketing blitz of seed companies like Mahyco-Monsanto has succeeded in convincing many farmers to switch over to Bt cotton, often with devastating results, and yet such false promises and aggressive claims continue to this day.

The commercialization of Bt cotton in India is stimulated by the high expectations of corporations and local agribusiness about the enormous potential for profits in the seed market. Monsanto estimates the market potential for GM cotton in India at 8-12 million hectares over the next four years. It is clear that Monsanto and local seed companies will win the most from the potential penetration of Bt cotton in the future. As the Hindu Business Line stated in July 2006, the "carte blanche for GM crops in India [...] clearly puts the industry and not the Indian farmer at the centre of everything" (The Hindu Business Line, 2006d).

2.3 indonesia

2.3.1 monsanto pushes transgenic cotton in indonesia

Indonesia is a major importer of cotton, a raw material for its huge textile industry. In 2001, Monsanto Bt cotton was approved for commercial release by the Indonesian government and declared environmentally safe for planting in the country. The approval of Bt cotton in Indonesia was welcomed by Monsanto as another example of how this product improves farmers' livelihoods. Monsanto's Chief Technology Officer, Robert T. Fraley, said that Indonesia's approval was "good news for growers around the world who find the benefits of biotech products are well worth their investment in this technology" (Monsanto, 2002).

The three most populous Asian countries - Indonesia, China and India - have a combined population of 2.5 billion people, so the introduction of GM cotton in Indonesia was a very important step in Monsanto's strategy for the continent (James, 2002). The story of the introduction of Bt cotton in Indonesia is, however, very different from what Monsanto had anticipated. After three years, not only had Bt cotton failed to perform adequately in the field and angered most farmers, but its introduction involved a very serious episode of bribery and corruption, and an attack on national environmental regulations.

2.3.2 the introduction of bt cotton in the field

PT Monagro Kimia, a subsidiary of Monsanto US, started field trials of Bt cotton in Indonesia in 1996. Its main objective was to identify adequate varieties for cultivation in the country, specifically for South Sulawesi.

In February 2001, the Ministry of Agriculture issued a decree allowing the limited release of transgenic cotton Bt DP 5690B under the trade name NuCOTN 35B, or Bollgard, in seven districts of South Sulawesi. The next month, 40 tonnes of Bt cottonseed, imported by the Monsanto subsidiary, were flown in from South Africa. The seeds were trucked away under armed guard, to be sold to farmers in South Sulawesi (The Jakarta Post, 2001a).

Opposition was strong from the very beginning (Asia Times, 2001). Local NGO activists opposing the imports tried to block the trucks from leaving the airport, and protested against the use of the Indonesian military police to guard the vehicles. Activists said that the seed should be quarantined for detailed examination before distribution, and accused the company of attempting to disguise

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what it was doing by using trucks marked "rice delivery" (The Jakarta Post, 2001a). Protests continued in 2001, and hundreds of farmers and NGO activists joined a demonstration led by the Indonesian Federation of Peasants' Unions calling for a boycott of GM seeds and GM products. Farmers called for the destruction of the Bt cotton trials and other transgenic trials in the country, a halt to further releases of Bt cottonseed, and the eviction of Monsanto from the country.

In addition, a coalition of Indonesian groups took legal action against the February 2001 decree. They considered it as a violation of Indonesia's Environmental Law (23/1997), since no environmental impact assessment had been conducted and public participation was lacking. The decree had been issued on the quiet by the Agricultural Ministry, and not even the other ministries were informed. An editorial in the Jakarta Post characterized the decree as a sad case of when "business interests [...] prevail over environmental concerns" (Down to Earth, 2001). The NGO coalition lost the case in court in September 2001, but later that year the Environmental Ministry obliged Monsanto to undertake an environmental risk assessment (PanAp, 2001).

2.3.3 the failure of bt cotton

Monsanto promoted Bt cotton among farmers by arguing that it was environmentally friendly, required fewer pesticides, had better yields and would bring in more income. Branita Sandhini, a Monsanto subsidiary, provided the seeds and fertilizer through a credit scheme, and promised to buy the farmers' cotton at a good price (The Jakarta Post, 2002).

Pro-biotech sources were positive about the initial performance of Bt cotton in Indonesia. ISAAA's first conclusions in 2001 backed those of Monsanto, that "preliminary evaluations of Bt cotton indicate farmer income increases due to higher yields (30% average), reduced pesticide usage and better productivity". ISAAA also claimed that 2,700 farmers growing Bt cotton in the region of South Sulawesi were already benefiting from the new technology (James, 2001a, 2002).

Despite Monsanto's promises and propaganda, however, the Bt cotton was a failure, succumbing to drought and pest infestations. Many farmers complained about the claims of the superiority and performance of the genetically engineered cotton, and criticized Monsanto for its false promises (see box with Santi's testimony). Monsanto spokespeople continued to dispute the results of the planting, denying the testimonies of farmers like Santi, and repeating that farmers' productivity had increased (The Jakarta Post, 2002).

> "There are two possibilities for my cotton harvest: I will keep it until decayed or I will burn it, even though I might lose in production cost and effort, rather than sell it to Monsanto."
>
> **Baco, a farmer in Manyampa village, South Sulawesi.**

Ibu Santi Profile.

testimony by ibu santi, an indonesian farmer who burned her cotton fields

"My name is Santi. I am a farmer and the head of a group of women farmers in Bulukumba, South Sulawesi. One year ago, officers from the plantation office came to my door and persuaded me to plant Bt cottonseeds on our 25 hectares of farm land. They told me that it will yield a good harvest, a productivity of 4 to 7 tons per hectare. They said the company, Branita Sandhini [a subsidiary of Monsanto] that provides us with the seeds and fertilizers through credit schemes will buy our harvest at a good price, so we can pay our debt to the company and improve our welfare. So, despite my farmer group's doubt and our limited experience in cotton planting, I encouraged them to alter the cornfield into a Bt cotton field. For the sake of our welfare, to improve our future.

But that was a lie. Good harvest was nothing more than illusion. The harvest was very poor, just 2-3 rugs (around 70-120 kilograms) for each hectare. Far from helping, the company then raised the price of the seeds and fertilizer before the harvesting time and forced us to agree to that one-sided decision by signing the letter of agreement. If we didn't sign the letter, the company refused to measure or buy our harvest. The company didn't give the farmer any choice, they never intended to improve our well being, they just put us in a debt circle, took away our independence and made us their slave forever. They try to monopolize everything, the seeds, the fertilizer, the marketing channel and even our life.

I refused it. We, myself and my fellow group members, did not deserve this kind of fate. Many other farmers and their groups chose to surrender their independence but we didn't. Instead of signing the letter, we burned our cotton. We were angry about the company's dirty tricks, unfair treatment and empty promises. We demand justice so we burned our cotton to make the message clear. We are not bluffing. We know that we're risking our life by taking this position through the tide of intimidation and threat from local government and security officers, but we'd rather die protecting our right than surrender it to the hands of the company that has deceived us.

This is my testimony. A testimony that was based on my bitter experience, a traumatic one. The practice of Bt cotton planting has done more harm than good. Many of my fellow farmers have experienced the same things. Their voices were unheard, covered by the company's lies and our local government's repudiation that put the blame on our limited knowledge and experience. I speak for them, the unheard voices, for the injustice that they got, so that we can learn from the truth."

Source: *Konphalindo.*

2.3.4 bribery and corruption: how monsanto tried to bypass environmental regulations

In order to increase acceptance of GM crops in Indonesia, Monsanto needed a friendly regulatory framework for its GM products. Thus, since 1998, Monsanto has hired consultants in Indonesia to lobby for legislation and a ministerial decree favourable to GM crops (US SEC, 2005a). It was thanks to these activities that Monsanto obtained limited approval from the Ministry of Agriculture to grow Bollgard cotton in February 2001, as described above. But later that year, following a change in government, the Minister of Environment issued a decree requiring an environmental impact assessment as a condition for approving certain products, including Monsanto's Bollgard cotton (Asia Times, 2005).

When these new requirements were adopted, Monsanto consultants lobbied for their repeal (US SEC, 2005a). These efforts however proved to be illegal. The former State Minister for Environment, Nabiel Makarim, admitted in 2005 that Monsanto had lobbied him to facilitate the company's business in Indonesia. Nabiel also admitted that he had a close relationship with Harvey Goldstein, the Director of the Jakarta-based Harvest International Indonesia business consulting company. According to the Komisi Pemberantasan Korupsi (KPK), the Indonesian Corruption Eradication Commission, the consulting company had been hired by Monsanto to lobby the Indonesian government for legislation and ministerial decrees supporting the development of GM crops (The Jakarta Post, 2005b).

Evidence of bribery and other corrupt practices was found, and Monsanto was charged for violating the US Foreign Corrupt Practices Act. According to a criminal complaint lodged by the Department of Justice and the US Securities and Exchange Commission (SEC), an employee of the consulting firm that represented Monsanto paid $50,000 to a senior Indonesian environmental official in 2002, in an unsuccessful bid to amend or repeal the requirement for an environmental impact statement for new crop varieties. The SEC reported that: "Near the end of 2001, when it became clear that the lobbying efforts were having no effect on the Senior Environment Official, the Senior Monsanto Manager told the Consulting Firm Employee to 'incentivize' the Senior Environment Official with a cash payment of $50,000." As the SEC report shows, the cash payment was delivered by a consultant working for the company's Indonesian affiliate, but was approved by a senior Monsanto official based in the US and disguised as consultants' fees. Although the payment to the senior official was made, that official never repealed the environmental impact assessment requirement for Monsanto products.

The complaint also stated that over $700,000 in bribes were paid to at least 140 current and former Indonesian government officials and their family members between 1997 and 2002, financed through Monsanto's improper accounting of its pesticides sales in Indonesia. The largest single set of payments, totalling $373,990 in 1998 and 1999, was made in the name of the wife of a senior Ministry of Agriculture official to pay for buying land and building a new house.

Monsanto agreed to pay a $1 million penalty to the US Department of Justice (DoJ), which charged the company with violating the US Foreign Corrupt Practices Act when it bribed certain government officials to allow it to develop GM crops in Indonesia. The company also agreed to pay another $500,000 to the US Securities and Exchange Commission (SEC). Monsanto said that it had first become aware of financial irregularities connected with its Indonesian affiliates in 2001, and had begun an internal investigation. The company also said it had voluntarily notified US government officials of the results of this investigation, and had fully cooperated with the investigations by the DoJ and the SEC (US SEC, 2005a).

As part of the agreement with the DoJ and the Securities and Exchange Commission, Monsanto pledged to appoint independent consultants to review its business practices over a three-year period, at which point the criminal charges against it could be permanently dropped.

Christopher Wray, assistant US attorney general, said in a statement that the agreement required Monsanto's full cooperation and acceptance of responsibility for the wrongdoing. "Companies cannot bribe their way into favorable treatment by foreign officials," he said (Agence France Press, 2005). Charles Burson, Monsanto's general counsel, said: "Monsanto accepts full responsibility for these improper activities, and we sincerely regret that people working on behalf of Monsanto engaged in such behavior" (Monsanto, 2005i).

2.3.5 monsanto abandons commercialization of bt cotton in indonesia

Indonesia was ranked as a GM-producing country by ISAAA from 2001 until 2003. In 2004, Indonesia completely disappeared from ISAAA's widely publicized map (James, 2004). In December of 2003, the Minister of Agriculture finally announced that Monsanto had pulled out of South Sulawesi after three years of carrying out field experiments there. The company had stopped supplying seeds to farmers in February 2003, and by the end of the year had closed down its biotech cotton sales operations, keeping its business in Indonesia to sales of Roundup Ready herbicide and conventional corn seeds (Asia Times, 2005). Monsanto's justification for this retreat was that its cotton business in South Sulawesi was no longer economically viable.

Nonetheless, despite the fact that Monsanto has abandoned the commercialization of Bt cotton in Indonesia, the company continues to lobby for the introduction of other GM varieties, such as Roundup Ready corn, Bt Corn and Roundup Ready soy.

"In both its federal court complaint and its administrative order, the Commission charged that, in 2002, a senior Monsanto manager, based in the United States, authorized and directed an Indonesian consulting firm to make an illegal payment totalling $50,000 to a senior Indonesian Ministry of Environment official ('the senior Environment Official'). The bribe was made to influence the senior Environment Official to repeal an unfavorable decree that was likely to have an adverse effect on Monsanto's business. Although the payment was made, the unfavorable decree was not repealed. The Commission further charged that the senior Monsanto manager devised a scheme whereby false invoices were submitted to Monsanto and the senior Monsanto manager approved the invoices for payment.

In addition, the Commission charged that, from 1997 to 2002, Monsanto inaccurately recorded, or failed to record, in its books and records approximately $700,000 of illegal or questionable payments made to at least 140 current and former Indonesian government officials and their family members. The approximately $700,000 was derived from a bogus product registration scheme undertaken by two Indonesian entities owned or controlled by Monsanto. The largest single set of payments was for the purchase of land and the design and construction of a house in the name of the wife of a senior Ministry of Agriculture official. The Commission further charged that, in certain instances, entries were made in the books and records of the two Indonesian entities that concealed the source, use and true nature of these payments."

US Securities and Exchange Commission, 6 January 2005. Securities and Exchange Commission vs. Monsanto, Litigation n. 19023 (US SEC, 2005a).

2.4 australia

2.4.1 few farmers, huge farms

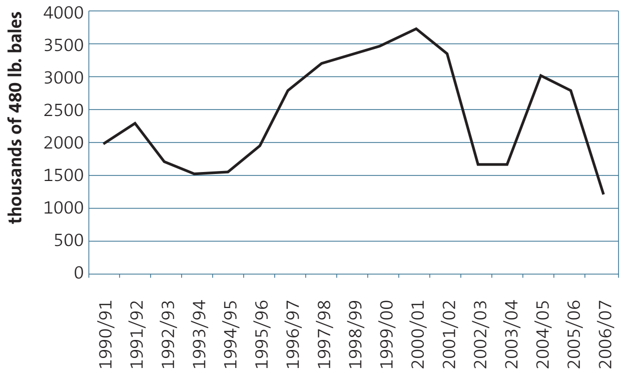
Australia has an intensive cotton industry that exports over 90% of its production. It has around 1,500 cotton farmers who work on roughly 500,000 hectares of cotton fields. Farm sizes are huge in comparison with the preceding countries described in this chapter, reaching over 15,000 hectares (IIEED, 2004; ISAAA, 2003).

2.4.2 low production in the cotton sector

The last four years have seen Australia's cotton sector hit by drought and low prices, with a series of sharp drops in production. In 2004/05, production recovered and was maintained throughout 2005/06, although production fell in the latter season despite an increase in planting area.

In 2006, as the price of cotton continued to be low compared to alternative crops such as sorghum, farmers were encouraged to cultivate other crops (ABARE, 2006). Low water availability has also heavily affected the output estimates for the 2006/07 season, which were revised from 350,000 metric tonnes (ABARE, 2006) to 230,000 metric tonnes (USDA, 2006v). Furthermore, in June 2006, Australia recorded the coldest and driest conditions for decades, significantly reducing the amount of irrigation water in catchment dams. As a result, at the end of November 2006 with planting for the season almost done, the projection of total cultivated land was estimated at only 147,000 hectares, which will mean the lowest production levels in 15 to 20 years (Globecot, 2006a,b).

FIGURE 3 **AUSTRALIAN COTTON PRODUCTION**



Source: *Globecot, 2006a.*

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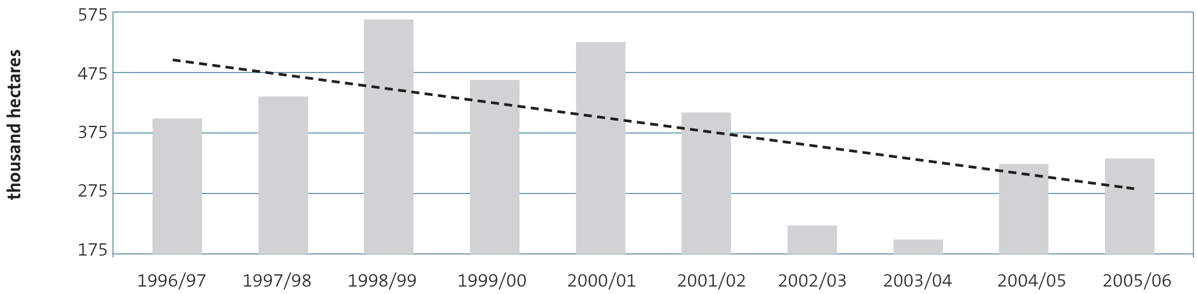
FIGURE 4 AUSTRALIAN COTTON AREA



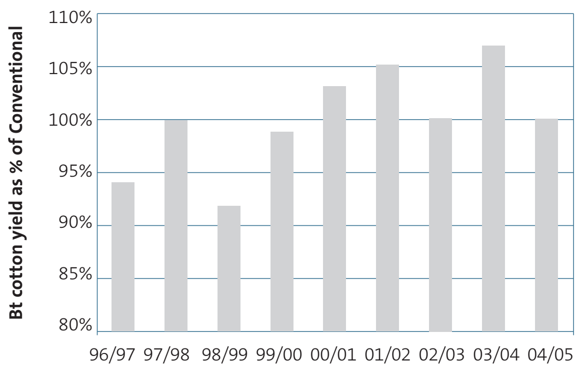
Source: *USDA, 2006v.*

2.4.3 the introduction of gm cotton in australia

In 1996, Australia's first GM cotton - Ingard - was released by CSIRO Plant Industry scientists together with Monsanto and seed company distributors. Now, after a decade of experience, the industry is claiming pesticide reduction and increased yields. A 2005 US Department of Agriculture (USDA) report says that "the successful introduction of genetically modified varieties has benefited Australia's cotton yield and production" (USDA, 2005m). But is GM cotton really providing greater yields and reducing pesticide use? Are farmers obtaining economic benefits in terms of net return?

The first answer is that there has been no benefit from the use of Bt cotton in terms of yield or quality (Browne et al., 2006). As figure 4 shows, the yields of Bt cotton in Australia have been relatively constant since its introduction in 1996, when compared with conventional varieties.

FIGURE 5 BT COTTON YIELD EXPRESSED AS A PERCENTAGE OF CONVENTIONAL



Source: *Cotton Consultants Australia.*

In the first few years of production, farmers made no profit from Bt cotton, and the companies marketing the product had to lower the technology fee in order to obtain some modest economic benefits (ISAAA, 2003).

In the first year of cultivation, Bt cotton had a significant negative economic benefit of minus A$262 (US$206) per hectare, due to higher insect control costs and lower yields, and exacerbated by a high technology fee of A$245 (US$192) per hectare. The technology fee was eventually lowered to A$155 (US$122), reducing insect control costs and resulting in a break-even or modest net economic benefit that ranged from A$6 (US$3) per hectare in 1998/99 to A$50 (US$28) per hectare in 1999/2000 (ISAAA, 2003).

Data analysis suggests that Bt cotton leads to reduced pesticide use; no publicly available studies contradict this. However, without comprehensive studies available, this claim cannot be legitimized. In any case, it is unclear if pesticide reductions also mean net economic gains for farmers, since the alleged pesticide decrease may be offset by the higher price of the seed.

There are a number of other factors that have raised questions about the sustainability of pesticide reduction. Research undertaken by Australian universities confirmed the resistance of cotton bollworm (Helicoverpa armigera) to Cry1Ac, the transgenic protein contained in Ingard. Scientists are also concerned about resistance to the second generation of Bt cotton, Bollgard II - which codes for both Cry1Ac and Cry2Ab toxins - due to the "semi-dominant status of the resistance mechanism, which makes management of Helicoverpa armigera resistance with Bollgard II cotton more difficult than resistance to the transgenic proteins of Ingard cotton". The Australian researchers conclude that "given that Helicoverpa armigera is a cosmopolitan pest of cotton and other crops, the existence of an esterase-mediated resistance mechanism may pose a considerable threat to the future efficacy of Bt transgenic crops worldwide" (Gunning et al, 2004). Clearly, there is a need for comprehensive independent research to evaluate the impact of bollworm resistance on pesticide use in Australian cotton production.

2.4.4 lessons learned in australia and future research

The most challenging factors over the past few years for Australian cotton growers were drought and low prices. A technology like Bt cotton can provide little or no help for farmers confronted with these problems. The severe cuts in production in 2005, together with the prediction that the 2006/07 crop will be the lowest in a decade, make it very difficult to believe USDA's 2005 claim that GM cotton has substantially benefited Australian cotton production.

Australia's experience is an example of a technology not answering the needs of a country's agriculture. Again, more comprehensive long-term evaluations of the impact of Bt cotton, and alternative sustainable methods of production should be undertaken in order to evaluate where the real agricultural challenges of cotton production lie.

3. cotton in africa

3.1 west africa

The economies of several West African countries are highly dependent upon cotton production. Francophone Africa's cotton region, also known as the 'Franc Zone', comprises Mali, Benin, Burkina Faso, the Ivory Coast, Cameroon, Chad, Togo, Senegal and the Central African Republic (USDA, 2002). Nigeria, while not in the so called 'Franc Zone', is also an important West African producer.

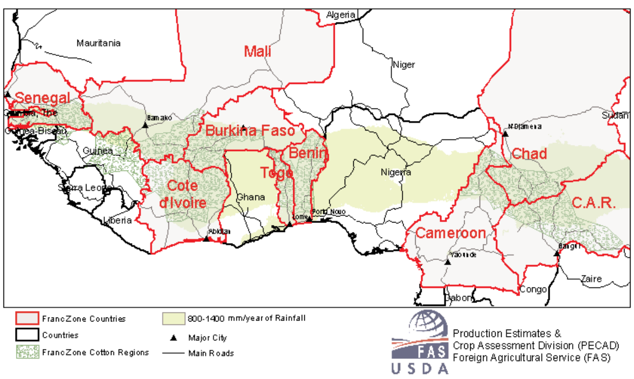
Cotton is the main source of cash income in many West African countries, and in parts of Mali and Benin cotton revenues make up an average of 75% of total cash per household (Pfeifer, 2005). More than two million households in West Africa are directly involved in cotton production, and many millions more in the region depend indirectly on cotton (OXFAM, 2002). Smallholders are the main cotton producers, and it was estimated that around 2.4 million hectares were planted with cotton in 2005/06 (USDA, 2005j).

TABLE 7 **HARVESTED AND PRODUCED COTTON AREAS IN 11 AFRICAN COUNTRIES, 2005/06**

AFRICAN COUNTRIES	AREA HARVESTED (IN THOUSAND HECTARES)	PRODUCTION (IN THOUSAND METRIC TONNES)
Burkina Faso	630	294
Mali	560	223
Zimbabwe	350	111
Nigeria	380	87
Chad	350	71
Benin	200	82
Ivory Coast	265	109
Egypt	273	201
Cameroon	225	90
Togo	105	30
Senegal	40	20
Total	3378	1318

Source: *USDA, 2006q.*

FIGURE 6 **'FRANC ZONE' COTTON REGIONS**



Source: *USDA, 2002.*

3.1.1 american subsidies: the curse of west african cotton farmers

World cotton prices have fallen by 54% since the mid 1990s, and these lower prices threaten the local communities that depend on cotton farming. Numerous factors are behind this decrease, but the most relevant is the increase in subsidies paid to cotton farmers in the United States. Western African farmers are seriously affected by this situation. In 2004/05, average world cotton prices fell by 35% from the previous year, but US cotton subsidies more than doubled from $1.750 billion to $4.3 billion (Oxfam, 2006).

In 2004/05, US producers received $4.3 billion in cotton subsidies, and according to the US Department of Agriculture, they received a total of over $18 billion in the six years between August 1999 and July 2005. The market value of US production during this period was $23.39 billion, meaning that there was a subsidization rate of 86%; for every dollar in sales, cotton farmers received an additional 86 cents in subsidies (Oxfam, 2006).

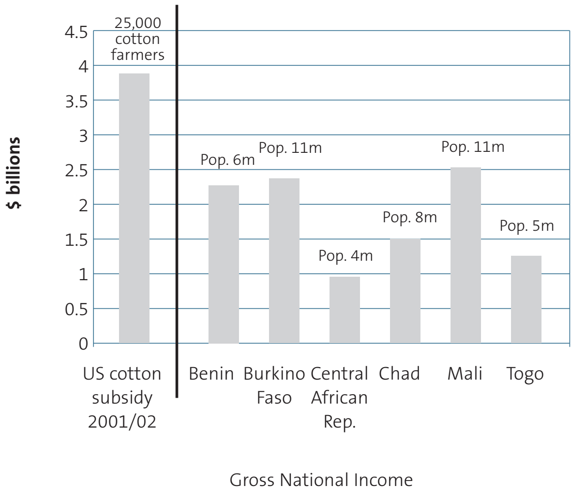
America's cotton farmers receive:

- *more in subsidies than the entire GDP of Burkina Faso* - a country in which more than two million people depend on cotton production. Over half of these farmers live below the poverty line. Poverty levels among recipients of cotton subsidies in the US are zero.
- *threefold more in subsidies than the entire USAID budget for Africa's 500 million people.*

Source: *OXFAM, 2006.*

FIGURE 7

US COTTON SUBSIDY AND THE GROSS NATIONAL INCOMES FOR SELECTED WEST AFRICAN COUNTRIES IN 2000 (IN BILLIONS OF US$)



Source: *World Development Indicators, World Bank, 2002, and USDA.*

african cotton farmers battling to survive

"In the small, remote village of Logokourani in western Burkina Faso, cotton is everything. It is the mainstay of that rural community, providing the major, and in some cases the only, source of income for many inhabitants. Cotton pays for health and education. It helps build houses and schools. Not too long ago, when exports of cotton increased in value, production expanded in that part of the country, raising village incomes.

But the collapse of the cotton price on the world market - it has fallen by 54 percent since the mid-1990s - threatens the very existence of communities such as Logokourani. 'Cotton prices are too low to keep our children in school, or to buy food and pay for health,' notes Mr. Brahima Ouattara, a small-scale cotton farmer in Logokourani. 'Some farmers are already leaving. Another season like this will destroy our community.'"

Source: *Gumisai Mutume, 2003..*

3.1.2 the push for bt cotton in west africa

Along with the other major West African cotton producing countries, Burkina Faso, the top cotton producer in the region, is under increasing pressure from the US government and multilateral organizations to rapidly introduce GM cotton (FoEI, 2006).

In July 2004, a Ministerial Conference was held Ouagadougou, Burkina Faso, co-sponsored by the US Department of Agriculture, USAID and the government of Burkina Faso. At this political milestone event, West African Ministers adopted a resolution calling for greater research and investment in agricultural biotechnology and recommending a West African Centre for Biotechnology.

December 2006 reports indicate that Burkina Faso's government may approve the use of Bt cotton varieties in the 2007/08 season. Monsanto's 'Market Potential for GM Cotton' states that there are 8.4 million hectares in Africa upon which Bollgard, Bollgard II, and Roundup Ready Flex technologies could be applied by 2010 (Monsanto, 2006i). These predictions are very significant when one considers that the top 12 cotton producers harvested an area of just over 3 million hectares in 2006. Monsanto apparently has its sights set on doubling GM cotton production in Africa.

3.2 cotton in south africa

3.2.1 decreasing production in the cotton sector

South Africa planted around 21,763 hectares of cotton in 2005/06. According to Cotton South Africa, the total area planted was 39% less than in the previous year, due to low international prices and a strong Rand against the US dollar at the time. Production estimates for 2006/07 are 18,114 tonnes, a 20% drop from the preceding season. The South African textile industry faces serious competition from low-priced finished products imported from China, and its exports are declining as a result (Cotton South Africa, 2005, 2006a,c).

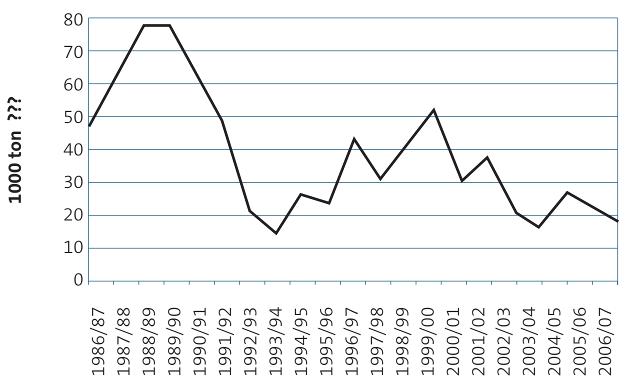
four the introduction of gm cotton in the world

TABLE 8 AREA PLANTED WITH COTTON IN SOUTH AFRICA

	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
Area planted in hectares	90,418	82,971	89,939	98,619	50,768	56,692	38,688	22,574	35,719	21,763	18,114

Source: *Cotton South Africa, 2006c.*

FIGURE 8 SOUTH AFRICAN COTTON PRODUCTION



Source: *Cotton South Africa*

According to Cotton South Africa, the number of small cotton farmers has been decreasing since 1996/97, from 3,655 in 1996/97 to 465 in 2002/03. In 2004/05, Cotton South Africa reported a total of 1,737 farmers (Cotton South Africa, 2006a,b,c).

Cotton South Africa also estimated that 86% of all commercial cotton was genetically modified in 2004/05. This figure dropped by 9% in the 2005/06 season, when an estimated 77% of total commercial cotton was genetically modified (Cotton South Africa, 2005).

3.2.2 gm cotton in the makhathini flats

The case of the Makhathini Flats in Maputoland, Northern KwaZulu Natal, South Africa is widely referenced and cited by US government agencies, Monsanto and the entire pro-biotechnology machinery as an African small farmer/GM success story (Pschorn-Straus, 2005). The Makhathini Flats is significant in that it is the place where the first smallholder farmers planted Bt cotton commercially in Africa.

In South Africa, cotton is a relatively minor crop, and the combined value of lint and seed production is no more than 1% of the total value of agricultural output. Around 300 commercial farmers, who grow on average 95% of South Africa's cotton, dominate cotton production (Hofs and Kirsten, 2001). Small-scale farmers make up the rest, with an ever-decreasing share of the market: 4% in 2000/1, an 8% drop from 12% in the 1997/98 season.

Since the beginning in 1997, the South African government has been behind the introduction of Bt cotton as part of a public-private partnership. The Land Bank (funded by the national government) has also been heavily involved in providing financial support. The provincial government has supported Bt cotton as part of its 'Green Revolution' policy, including mechanization (Linscott, 2002). Thus, both the national and regional governments have injected money into supporting the expansion of Bt cotton in the area. Additionally, the Makhathini Flats farmers were provided with irrigation infrastructure, subsidized inputs, and a guaranteed market for their harvest by the local government and Vunisa Cotton (which works closely with Monsanto South Africa).

Monsanto embarked upon a crafty marketing exercise, telling farmers that "the muti is in the seed", 'muti' being the term used for traditional medicine in South Africa. The message being sent to farmers was that if they used the Bt cottonseeds they would be rewarded in multiple ways: better yields, and funding to purchase farming equipment. For an impoverished community, this was more than enough incentive to use the seeds. The adoption rate of Monsanto's Bt cotton by the Makhathini farmers was initially very high: 90%, owing to support by the government and successful marketing by Monsanto (FoEI, 2006).

It was later discovered that farmers were given a very limited choice, as seed distributors offered only four varieties of cotton, three of which were GM, compared to 12 varieties offered nationally. Witt et al. concluded that "the adoption of GM cotton is symptomatic not of farmers' endorsement of GM technology, but a sign of the profound lack of choice facing them in the region" (Witt et al, 2005).

With the passage of time, the total area planted by the Makhathini farmers declined from 276 hectares in 2000/01 to 193 hectares in 2001/02 and 180 hectares in 2002/03. In total, 66% of the farmers either reduced the planted area or completely stopped planting cotton. By the end of 2003, very few farmers planted cotton. By 2004, only 700 farmers delivered cotton at the ginnery - down from a total of 3,000 farmers planting cotton in 2000 - equivalent to a staggering 80% drop in farmers growing Bt cotton.

Despite this situation, ISAAA continued to paint a rosy picture of the success of small-scale South African farmers in its annual reports. Its 2003 report said: "Notably, more than 85% of these 7 million farmers benefiting from GM crops in 2003 were resource-poor farmers planting Bt cotton, mainly in nine provinces in China, and also in the Makhathini Flats in Kwazulu Natal province in South Africa" (James, 2003). In its 2004 report, "subsistence farmers in the Makhathini Flats" are prominently mentioned among the 7 million resource-poor farmers that benefited from GM crops in development countries (James, 2003). Finally, in its 2005 report, ISAAA referred to the thousands of small farmers in South Africa, mainly women, who benefited from Bt varieties.

However, a look at the statistics for the Makhathini Flats shows that ISAAA has pumped up the relevance of small farmers. In 2003, the number of cotton planting farmers in Kwazulu Natal was an estimated 353; in 2004 the number was 1,594; and in 2005 the figure was back down to 598. This variation indicates that Bt cotton is not driving cotton cultivation in the province, but that they key factors are the above-mentioned socio-economic conditions.

TABLE 9 **NUMBER OF SMALL-SCALE COTTON FARMERS IN KWAZULU-NATAL**

2001/02	2002/03	2003/04	2004/05
3229	353	1594	598

Source: *Cotton South Africa, 2006b.*

Regarding yield, statistics by Cotton South Africa show constant yield levels before and after the adoption of Bt cotton; Monsanto's claims of rising yields were thus unfounded (Witt et al, 2005).

In the final analysis of farmer income, a study found that only 4 farmers of a total sample of 36 had made a profit. The total loss of these 36 farmers came to US$83,348, and most of them had accumulated massive debt. In a 2004 interview, a Land Bank official said that the debt figure for the whole area totalled just over US$3 million. This amount, owed by 2,390 farmers, broke down to an average of US$1,322 per farmer. Around 80% of the farmers had defaulted on their loans (Pschorn-Straus, 2005).

We have not found any comprehensive publicly available study on pesticide use in the Makhatini Flats area. However, analyses of cases in China by pesticide application experts have implied that "while pesticide application to control bollworm has fallen in the period since the introduction of Bt cotton, these reductions have been countervailed by increased pesticide application to ward off secondary insects such as jassid, whose appearances have substantially increased since the introduction of Bt cotton" (Witt et al, 2005).

Unfortunately, there is no empirical evidence in the form of financial records that would allow for a comprehensive analysis of crop yields and living standards in the Makhathini Flats before and after GM cultivation. Substantive claims as to the success of GM cotton there by GM corporations such as Monsanto are thus both irresponsible and unjustified. A further critical factor is that the drop in international cotton prices has forced Makhathini farmers to question the choice of GM cotton as a viable cash crop. In sum, what has emerged clearly is that Bt cotton did not help the farmers crawl their way out of poverty. Indeed, the problems faced by resource-poor farmers in Africa are complex and cannot be addressed by quick techno-fixes.

Influential senior managers of corporations like Monsanto have turned a blind eye to the dire situation of farmers in the Makhathini Flats and the lack of improvement in the livelihoods of small farmers. Rob Horsch, former vice-president of Monsanto, stated that one of the main reasons for his passion for working for 'development for the developing world' is the great successes he saw when "he was visiting cotton growers in South Africa, and seeing and hearing first-hand what success with Bollgard insect-protected cotton meant to them" (Monsanto, 2006b). Horsch has recently moved to a senior position at the Bill Gates Foundation, with a mission to "improve crop yields via the best and most appropriate science and technology, including biotechnology, for problems in regions including sub-Saharan Africa".

4 cotton in the united states

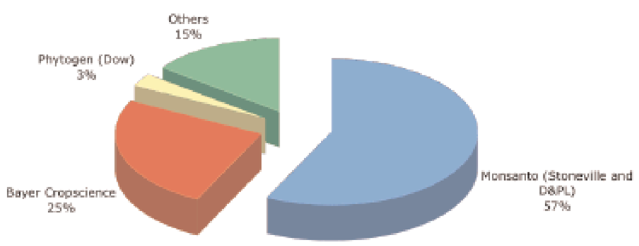
4.1 cotton industry concentration

The US is the second largest producer of cotton in the world, and its top exporter. The country planted an area of 5.5 million hectares in 2005/06, and exported approximately 3.9 million tonnes (USDA, 2006q).

In the US, the cotton industry is largely based on intensive farming, with farm sizes varying from an average of 800 hectares in Texas to some 200 hectares in the Carolinas and Mississippi. There are a total of about 25,000 cotton farmers across the country (IIED, 2004)

Over 80% of the planted cotton varieties in the US fall into three brands. The most popular variety is from Delta and Pine Land (43.2%), followed by Bayer Crop Science (25.3%) and Stoneville (13.9%). Monsanto acquired Stoneville in 2005, and is in the process of buying Delta and Pine Land, meaning that it will control the first and third most popular cotton brands, together representing around 60% of the US cotton market (The New York Times, 2006). The merger, which carries the risk of creating a Monsanto monopoly, will provide the company with a solid cotton 'platform' for traits, germplasm and seeds (The American Antitrust Institute, 2006b).

FIGURE 9 US COTTONSEED MARKET, 2005



Source: *ETC, 2006.*

The acquisition of Delta and Pine Land may lead to an acceleration of GM trait penetration in the US (Monsanto, 2006c). A recent paper by the American Antitrust Institute confirmed the reduction in seed choice for farmers, stating that "the merger could also reduce choices available to cotton farmers by hastening the elimination of conventional (non-genetically modified) cotton seed" (The American Antitrust Institute, 2006a).

proposed merger potentially reduces available choice for cotton farmers

Before the advent of cotton biotechnology, farmers cultivated conventional varieties of the plant. Although genetically modified cotton has gained in popularity since its introduction in the late 1990s, and now accounts for about 83% of all planted acreage in the US, there is still demand for these conventional varieties. In Texas and California, for example, the penetration of genetically modified cotton has been much lower, perhaps due to local climate and ecology.

Given Monsanto's dominance in the cotton arena and its apparent goal of creating an integrated platform for GM cotton, the merged company would have little incentive to continue Delta and Pine Land's production of conventional cotton seed. A potential phase-out of conventional varieties after the merger could raise problems for farmers who still want non-GM varieties, reducing choice and potentially raising costs, and leading to higher prices of cotton-based products for US consumers.

Source: *The American Antitrust Institute, 2006b.*

4.2 performance of gm cotton

GM cotton varieties accounted for 82.6% of the 'upland' cotton planted in the US in 2005. (Upland cotton is the main type of cotton grown in the US, mostly in the states of Virginia, Oklahoma, Texas, New Mexico, Arizona and California.) The adoption of GM cotton varied from 100% in Tennessee to 43.5% in California (ICAC, 2005).

ISAAA reported on the results of Bt cotton in the United States as including "an average increase of 10% or more in yield, a reduction of 2.2 insecticide sprays that translated to approximately 850 MT less insecticide used in 2001, with significant positive implications for the environment".

According to ISAAA, these benefits would offset the higher cost of Bt seed, resulting in overall benefits of $50 to $85 per hectare (James, 2001a).

However, analysis by Benbrook shows that pesticide use has in fact not decreased since the introduction of GM cotton. Heavier weed pressure led to an estimated 10% rise in the average volume of herbicide applied per cultivated acre in the first two years of commercial use, even though HT cotton was shown to cut herbicide use by one third of a pound per acre in 2004 (Benbrook, 2004). Although Bt cotton varieties did reduce insecticide use, total herbicide plus insecticide use increased by a total of 15.7 million pounds between 1996 and 2004.

TABLE 10 **HERBICIDE USE IN CONVENTIONAL AND ROUNDUP UPLAND COTTON VARIETIES, 1996-2004**

	1996	1997	1998	1999	2000	2001	2002*	2003	2004*
ACRES PLANTED	14,100,000	13.558,000	13,064,000	14,241,000	15,347,000	16,054,000	13,714,000	13,900,000	13,900,000
HT ACRES PLANTED	2,058,600	2,033,700	2,194,752	4,841,940	7,059,620	8,990,240	7,954,120	8,201,000	8,340,000
PERCENT ACRES PLANTED									
HT VARIETIES	14.6%	15.0%	16.8%	34.0%	46.0%	56.0%	58.0%	59.0%	60.0%
GLYPHOSATE/RR	14.6%	14.0%	12.8%	27.0%	40.0%	55.0%	57.0%	59.0%	59.0%
BROMOXYNIL	NA	1%	4%	7%	6%	1%	1%	1%	1%
RATES PER ACRE									
NASS AVERAGE ALL HERBICIDES	1.88	2.09	1.88	1.88	1.84	1.65	1.84	1.99	2.20
GLYPHOSATE ON RR ACRES	0.63	0.79	1.02	1.04	1.14	1.12	1.25	1.38	1.50
OTHER HERBICIDE ON RR ACRES	0.95	1.05	0.95	0.95	0.95	0.80	0.90	1.05	1.10
TOTAL RR ACRES	1.58	1.84	1.97	1.99	2.09	1.92	2.15	2.43	2.60
CONVENTIONAL VARIETIES	1.93	2.16	1.96	2.03	1.86	1.35	1.46	1.42	1.67
DIFFERENCE IN POUNDS PER ACRE BETWEEN HT TRANSGENIC AND CONVENTIONAL VARIETIES	-0.35	-0.32	0.01	-0.04	0.23	0.57	0.69	1.01	0.94

** Herbicide rates in 2004 are preliminary estimates based onrecent trends. There was no cotton pesticide use data collected by USDA in 2002.*

Herbicide-tolerant cotton reduced herbicide use in three of the first four years of commercial use. Thereafter, however, increasingly more herbicides were needed to keep up with weed shifts and resistant or tolerant weeds. This led to the use of 26.8 million more pounds of herbicides over a nine-year period than if conventional varieties had been used.

The planting of Bt cotton, on the other hand, resulted in a substantial drop of 11 million pounds of insecticides. However, taken in combination, GM traits in cotton led to an increase of 15.7 million pounds in combined herbicide plus insecticide use from 1996-2004 (Benbrook, 2004).

4.3 what are the benefits from gm cotton in the us?

Some of the claimed benefits of GM cotton are questionable on the basis of existing literature. GM cotton is not better quality, nor does it provide higher yields. Benbrook has shown that total herbicide use in the US has risen by more than insecticide use has fallen. This raises doubts about what seemed to have been the main benefit of GM cotton, its positive impact on the environment. Studies that have comprehensively analyzed pesticide use, bollworm resistance, weeds, and farmers' net returns across different seasons are key in evaluating the real benefits of GM cotton. Without such investigations, the industry-publicized benefits of GM cotton cannot be taken for granted.

four the introduction of gm cotton in the world

Furthermore, the increasing monopolization of the industry, particularly the merger of Monsanto with Delta and Pine, constitutes a significant challenge for US farmers and consumers. Monsanto's behavior in the last decade indicates that its increased control over the vertical chain of cotton production will almost certainly contribute to further reducing choices for farmers and consumers.

5. cotton in latin america

5.1 introduction

GM cotton is commercially authorized in Argentina, Colombia and Mexico. There is strong pressure in Brazil and Paraguay for its approval.

5.2 argentina

5.2.1 argentinian cotton sector suffers from decreased production

The past decade in Argentina has been characterized by a significant drop in the area used for cotton production, from over 1 million hectares in the 1995/96 season to 158,209 hectares in 2002/03. The country's cotton industry was badly affected by low international prices and lack of financing, and struggling farmers chose to plant soybeans rather than cotton (USDA, 2001, 2003).

In the last three years, rising prices began to push up the production area once again, and the area is predicted to further expand if US cotton subsidies are cut (USDA, 2006u). However, this expansion will be led by large-scale investors in southwestern Chaco and eastern Santiago del Estero, using advanced plantation technology with narrow furrows, Roundup Ready seed and strict management (USDA, 2005l). For small and medium-scale farmers who have very little access to credit, the financial situation is much more depressing (USDA, 2005l).

TABLE 11 COTTON PRODUCTION AREA IN ARGENTINA, 1995-2006.

COUNTRY TOTAL	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Area planted in hectares	1,009,800	955,560	1,133,500	750,930	345,950	410,905	174,043	158,209	266,387	406,215	315,000

Source: *SAGPYA and USDA, 2005l.*

5.2.2 gm cotton in argentina

In Argentina, approval was granted for Bt cotton in 1998 and Roundup Ready cotton in 2001. GM cotton now accounts for around 60% of the region's planted area (Levitus, 2006). According to Argentbio, 88% (165,000 hectares) of the crop is glyphosate-tolerant Roundup Ready and 12% (22,500 hectares) is Bt cotton (Argenbio, 2006). Only about 21% (40,000 hectares) of this is estimated to be official seed; the rest is what is known as 'brown bag' or black market seed (USDA, 2005l).

The USDA has acknowledged that there is a lack of thorough fieldwork on GM cotton in Argentina (USDA, 2004d); as yet there is no publicly available comprehensive analysis that examines the impact of several seasons of cultivation in terms of pesticide reduction, net returns to farmers, and resistance.

5.3 mexico

5.3.1 a decade of crisis for the mexican cotton sector

In 1996, Mexico and the United States became the first two countries to plant Bt cotton commercially (Traxler, Godoy-Avila, 2004). In the same year that Mexico began to cultivate GM cotton, total production of the crop in the region began to fall, and farmers entered one of the most serious crises the cotton sector has ever seen. "Depressed world prices, insufficient government support and irregular weather" were quoted as the main causes for the situation (USDA, 1998).

The severity of the plunge in cotton prices forced Mexico to introduce an emergency support program in 1999 in order to prevent cotton producers from shifting to other crops. Deflated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prices and increased production costs were leading to very low profits for farmers (USDA, 1999). But the Mexican cotton sector received the heaviest blow in 2002, when production plummeted 50% below levels of the previous year. Once again, international prices, low governmental support and increased costs were to blame (USDA, 2002).

TABLE 12 **AREA CULTIVATED IN MEXICO WITH COTTON, 1996-2006.**

COUNTRY TOTAL	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006 ESTIMATE
Area planted in 1,000 hectares	315	214	250	149	80.2	91.9	40.5	62.9	110	130	115

Source: *Servicio de Información Estadística Agroalimentaria y Pesquera SIAP/SAGARPA and USDA, 2006r.*

In 2004, production began to pick up, rising from around 60 million hectares to 110 million due to higher cotton prices and anticipated increases in government support (USDA, 2004c). Production is however predicted fall once again in the 2006/07 season, which the USDA attributes to outbreaks of white fly infestation, especially in the states of Sonora and Sinaloa, and a late announcement by the Ministry of Agriculture about the details of its cotton price support program, leading many farmers to choose to plant other crops rather than cotton (USDA, 2006r).

5.3.2 gm cotton area in mexico expected to decrease in 2006/07

Bt cotton was introduced in Mexico in 1996. In 2005, the country planted around 130,000 hectares of cotton, an estimated 65% of which was genetically modified. Traxler and USDA reports argue that Bt cotton has been key in slashing pesticide use and raising net returns for farmers (Traxler and Godoy-Avila, 2004). However, the first troubled eight years of the introduction of Bt cotton indicate that the technology has played little or no role in improving the livelihoods of cotton farmers. Instead, the critical factors have been socio-economic - the aforementioned international prices and lack of government support - rather than transgenic.

GM production in 2006/07 is expected to be lower than in the previous season, and most of this decline is anticipated to be in Sonora and Sinaloa, the states affected by the white fly outbreaks. It is anticipated that less than 3,000 hectares will be planted in Sonora in the coming season, compared with around 22,000 hectares in 2005/06. Overall Mexican production of GM cotton is expected to drop from around 70,000 metric tonnes to 50,000 metric tonnes during the coming period (USDA, 2006r).

5.4 colombia

Colombia cultivated a total of 57,424 hectares of cotton in 2006, a drop of 21.7% from the previous year. The Colombian government estimates that 25,083 hectares of this cotton, representing 43.7% of the total area, was planted with the Bollgard I genetically modified seed.

The economic situation of the country's cotton sector is not positive. In addition to the decline in planted area, lint production dropped by 18.6% in 2006 due to prohibitively low international prices, the revaluation of the national currency, higher production costs and limited access to credit. Farmers in Colombia are concerned about the high cost of GM seeds, the inadequate biosafety measures related to the new technology, and the susceptibility of the seeds to poor weather conditions (Republic of Colombia, 2006).

The USDA has identified problems with the use of Bt cotton that will particularly affect small farmers in some parts of Colombia, and stated in a 2006 report about Bt cotton that "there are still pest appearances that are escalating up costs and causing damages to the production, particularly for small producers" (USDA, 2006t). Paradoxically, the report nonetheless declares that despite the failure, "growers are waiting for the second generation of biotech material".

TABLE 13	COLOMBIA: EVOLUTION OF COTTON AREA, PRODUCTION AND YIELDS, 2005-2007		
COUNTRY TOTAL	**2005**	**2006 PRELIMINARY**	**2007 ESTIMATED**
Area cultivated (hectares)	73,306	57,424	51,883
Production of fibre (metric tonnes)	55,471	44,790	42,236
Yield (kilograms per hectare)	757	780	814

Source: *Republica de Colombia, 2006.*

5.5 the push for bt cotton in brazil and paraguay

Brazil is under increasing pressure to adopt Bt cotton. The national Ministry of Agriculture recently publicized its detection of 18,000 hectares of illegally cultivated HT cotton on Brazilian farms. This crop is not authorized for commercial production, but two applications for approval are being evaluated by CTNBio, the regulatory authority: one for Bayer's Libertylink cotton, and the other for Monsanto's Roundup Ready variety (Paiva, 2006).

The US Department of Agriculture describes the advent of large-scale GM cotton planting as "the key to enhanced profitability" for cotton farmers. Even though the Bt variety is not yet commercially approved, the USDA reports that Brazilian producers have been stocking up on it for planting in 2007, and there are plans to increase legal supplies of RR cotton varieties in 2008 (USDA, 2006n).

Furthermore, it has been reported that Monsanto is trying to finalize a royalty agreement with farmers, despite not yet having the legal authorization for planting. Jorge Maeda, president of the Brazilian cotton farmers' association, resigned from his position after declining to sign an agreement between Monsanto and cotton farmers establishing the payment of royalties for the use of Bollgard transgenic insect-resistant cottonseed (Gazeta Mercantil, 2006).

Similarly, while Paraguay has not approved GM cotton, the pressure for its adoption is mounting. Curiously, USDA contacts report that they believe some Bt varieties are being planted in the country, although approval is far from immediate. The USDA also states that some technicians in Paraguay believe that "many things have to improve before small producers use this type of seed which, when properly used, provides many advantages, although it is significantly more expensive than conventional seed" (USDA, 2006b).

6. the growth in organic cotton

The organic cotton sector has grown dramatically in many parts of the world over the past six years. Estimated global retail sales of organic cotton products increased from $245 million in 2001 to $583 million in 2005, reflecting an annual average growth rate of 35% (Organic Exchange, 2006a).

Despite a relatively small cultivation area, total organic cotton production rose by 292% between 2000 and 2005, a far bigger increase than with conventional or GM varieties, and the crop has very good prospects for future expansion (Intercot, 2005).

7. conclusions

A close look at the publicly available documentation analyzing the performance of Bt cotton and the implications of its release show a less rosy picture that what ISAAA would lead us to believe. It is important to note that for ISAAA, GM cotton is the key crop supporting its assertion that biotechnology aids poor subsistence farmers in developing countries. A total of 6.4 million Chinese and 1 million Indian small-scale farmers, as well as thousands in South Africa, are supposed to have benefited from GM technology; as ISAAA claimed in 2005, "7.7 million poor subsistence farmers benefited from biotech crops".

None of ISAAA's recent briefs report any problem with Bt cotton production in China, India or South Africa. Its statistical analyses are based on the assumption that planting Bt cotton results in successful crop performance, good yields, and direct improvement of the livelihood of small farmers. However, the recent Cornell University study documenting the financial losses suffered by Bt cotton farmers in China due mainly to secondary pests; the ban of the first commercialized varieties in

Andhra Pradesh and the continuous livelihood challenges for Indian farmers; and the rejection of Bt cotton by Indonesian farmers all indicate that there are serious problems associated with the release of GM cotton.

In India, Bt cotton can not address the main structural problems of the agrarian crisis that has left small cotton farmers poor and indebted. Bt cotton has not been able to improve the livelihoods of the small farmers in the Makahatini Flats of South Africa, who have been affected by falling cotton production as well as problems with pricing and inputs. Monsanto's abandonment of Bt cotton in Indonesia is another striking example of the problems associated with the crop. Yet none of these cases are mentioned in ISAAA analyses.

A closer examination of other countries that have introduced GM cotton reveal similar problems. In Argentina, Mexico, and Colombia, cotton production in general has declined sharply over the past decade, with low international prices posing the main challenge for farmers. Transgenic technology has been of little or no use in this context. In Mexico, the area planted with Bt cotton is expected to significantly decrease in 2006/07, and in Colombia farmers complain about the high costs of the seed and the lack of biosafety measures.

Bt cotton has improved neither yields nor the quality of cotton fiber. In Australia, for instance, yields have remained constant since the introduction of Bt cotton, and this technology has contributed nothing to ameliorating the drought and low prices farmers struggle with there.

The analysis of pesticide use is very complex, and there is a clear lack of comprehensive research available. Benbrook's analysis of the US situation prior to 2004, however, shows that pesticide use has in fact not decreased since the introduction of GM cotton. Although insecticide use decreased on Bt crops in comparison with conventional ones, this was offset by the increased application of herbicides. ISAAA's claim that pesticide use fell by 172,500 metric tonnes between 1996 and 2004 thus does not appear to have any solid scientific value.

Clearly, GM cotton technology does not appear to tackle the key issues linked with the livelihoods of small farmers around the world, including international prices and lack of governmental support. In West Africa, for example, low prices have been identified as the main obstruction to the livelihoods of two million farmers. How can a technology like Bt cotton solve their problems? And why do US agencies organize ministerial meetings like the one in Burkina Faso to promote biotech cotton, instead of adopting policies to eliminate subsidies to their 25,000 cotton farmers at home?

Furthermore, Bt cotton will not resolve the problems of drought or secondary pests. On the contrary, the expansion of Bt cotton cultivation will more likely contribute to further weed and pest-resistance problems, further challenging attempts by farmers to create sustainable livelihoods.

It is time for the GM industry to take a 'time out' in its aggressive commercialization of GM cotton so that independent research can evaluate the performance of the crop around the world. GM cotton does not yield more than conventional varieties, and it is not clear that farmers are economically benefited. Even the advantage that has been most widely accepted - the convenience effect of spraying less pesticide - is predominantly enjoyed by large-scale farmers, and not by the small-scale majority.

GM cotton has not proven better than conventional cotton, and the benefits claimed are highly questionable. Instead, more attention is needed for sustainable non-transgenic alternatives such as organic cotton, the demand for which has increased dramatically in recent years.

five europe resists biotech takeover

europe resists biotech takeover

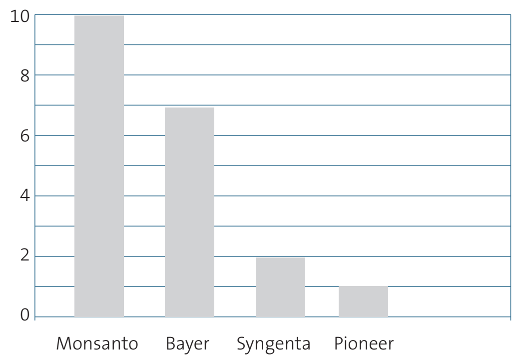
adrian bebb, friends of the earth europe

Despite widespread opposition in Europe to GM foods and crops, the biotech industry is targeting the European Union (EU) with dozens of new applications. Whilst many of these applications are aimed at animal feed, or to avoid legal problems if contamination is found in imports from countries growing GM crops, a surprising number of applications are for commercial growing in the EU. Despite the fact that there has been no approval of a crop for cultivation since 1998, the industry believes that it can now break Europe's resistance. In reality however, the public's opinions on GM products continue to harden, with research showing public rejection levels today higher than those in 1996.

1. europe's market leader

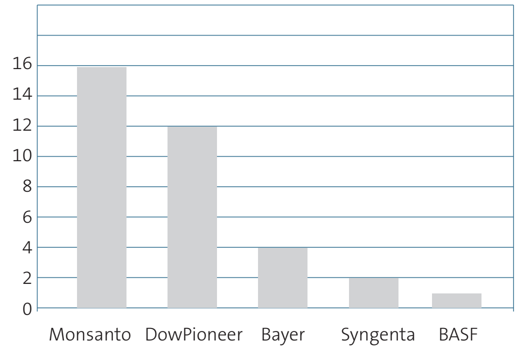
Monsanto is currently the company with the most GM products approved in the EU, having pulled ahead of Bayer when its MON863, GA21 and MON863xMON810 maize products were approved for import in January 2006 (see table 1). There has been a remarkable surge in new applications from both Monsanto and Dow/Pioneer recently (see table 2). There are now 35 applications in the pipeline - a jump from 23 in 2005 (European Commission, 2006a). Monsanto remains ahead of Dow/Pioneer, and also has interests in applications by other companies that are using Monsanto technology. For example, Bayer has applied for permission to sell its Liberty Link cotton crossed with Monsanto's 15985 cotton.

TABLE 1 NUMBER OF GMOS APPROVED FOR COMMERCIAL IMPORT OR CULTIVATION IN THE EU



Source: *European Commission*

TABLE 2 NUMBER OF GMOS PENDING APPROVAL IN THE EU



Source: *European Commission*

1.1 the influence of the industry lobby

The impacts of the biotech industry's lobbying in Europe can be seen from its success in influencing decision-makers. Despite overwhelming public objection, some national governments and the European Commission continue to support and push GM foods and crops. This is no coincidence, and shows the real influence of industry lobbying.

1.2 the lobby groups

The two most significant European GMO lobby groups are the European Association for Bioindustries (Europabio) and the European Seeds Association (ESA).

Europabio is the main lobby group for the GMO industry in Europe. Besides Monsanto, its members include Bayer, Syngenta and Dow Chemicals. Although Europe has some of the most comprehensive GMO legislation in the world, lobbying by Europabio and its members has resulted in weaker standards than those demanded by the public.

Europabio is now pushing European institutions to support GMOs for the sake of "growth, competitiveness and jobs". The lobby group even claims that GM crops will be good for the environment, claiming in one of its publications that: "Today, agriculture biotechnology can help European farmers to grow crops more efficiently while providing sustainable options that can improve farmland, wildlife and diversity" (Europabio, 2005b).

The reality is vastly different. The most comprehensive environmental trials of GM crops ever to have been done in the world were conducted in the UK over a four-year period between 1999 and 2003 (DEFRA, 2006). Farmers grew GM crops alongside conventional ones, and scientists examined the impacts on wildlife from both crops. The GM crops were grown following agronomic guidance from the GMO industry. Of the four different GM crops tested, three were shown to have damaging effects on wildlife, and follow-up research has suggested that these effects are likely to persist for many years. The biotech industry chooses to ignore inconvenient outcomes like these, despite the comprehensive research and clear results.

The biotech industry's other vehicle is the European Seeds Association (ESA). One of the most contentious GMO issues in Europe is the contamination of conventional seeds by genetically modified ones. The ESA has long lobbied for weak standards that would lead to widespread contamination of both agriculture and the environment (European Seed Association, 2003, 2004).

1.3 cbag and biofrac: the industry's high-level working groups

The European Commission (the EU's executive body) is fond of using high-level working groups. Not surprisingly, such a group exists for biotechnology, called the Competitiveness in Biotechnology Advisory Group (CBAG). Monsanto, Syngenta, Bayer, BASF and Europabio are all members of CBAG (European Commission, 2006b). In addition, Europabio has until recently participated in another working group to develop biofuels: the Biofuels Research Advisory Council (BIOFRAC).

High-level groups are largely focused on supporting industry, and groups representing civil society are often barred from participating. The CBAG falls under the Directorate General for Enterprise - one of the most pro-GM Directorates within the European Commission. In correspondence to Friends of the Earth Europe, the Commission stated: "It has not been easy to organize meetings, as the members' agendas are heavily charged. [...] For this reason, there are no meeting minutes that I can transmit."

Although CBAG is apparently too busy to meet, it has miraculously produced a number of high-level annual reports that are used by the Commission. In its latest report, CBAG is particularly disparaging of political opposition to GM crops, calling it "irresponsible and unbalanced: disadvantaging needy people for the sake of the niceties of our own unnecessarily tough regulations". In addition, the industry believes that Europe's precautionary measures "are costly, and serve no health or public safety purpose. [...] Legislation that is lighter but which can be properly implemented and enforced would seem to be a preferable option" (European Commission, 2006c).

The industry lobby is now calling for compensation for the time it takes to get a product approved: "The period of patent protection lost due to regulatory delays should be measured, its impact on competitiveness established, and the inventors compensated by an extension of protection" (European Commission, 2006c).

CBAG is highly critical of the media for reporting negatively about GMOs: "The average citizen cannot be expected to wholeheartedly accept products, substances or plants which are perceived insufficiently tested or not properly authorized." They conclude that: "because of the actions of some Member States in the registration procedure, entrepreneurship is inhibited, consumers are confused, and there is a lack of confidence" (European Commission, 2006c).

BIOFRAC contains many companies who are keen to benefit from the use of biofuels, such as the oil industry and car manufacturers. The biotech industry is represented by Europabio. In 2006, BIOFRAC produced a report that called for more biofuels, and not surprisingly, the use of dedicated energy crops and the use of biotechnology. This is clearly a branch that the industry is now pushing (Biofuels Research Advisory Council, 2006).

2. monsanto's plans for europe

Despite the clear opposition to GM foods and crops in Europe, Monsanto is still attempting to persuade its investors that it will succeed on this continent. At its Investor Day in November 2006, Monsanto once again outlined ambitious plans for expanding its control of agriculture in Europe over the coming years (Monsanto, 2006g). The company will continue to target European maize production over the next four years, claiming that this is a market opportunity for biotech traits.

And Monsanto is not restricting itself to GM seeds. At the 2006 Investors Day, the company claimed that its subsidiary, Dekalb, is now the "co-leading" brand for maize seeds in France. It stated that: "From 2003-2005, Monsanto led the way with 36 new corn grain hybrids or 19% of the total new product entrants approved in France." Over the same period, the company claims to have increased its market share of maize seeds by 7% in Italy, 6% in Hungary and 4% in Turkey. Monsanto now controls 15% of the French market, 21% of the Italian market, 32% of the Hungarian market and 21% of the Turkish market in maize seeds. The takeover of the conventional seed market is a worrying sign, especially from a company determined to introduce GM varieties.

TABLE 3 MARKET POTENTIAL FOR BIOTECH TRAITS HIGHLIGHTS CONTINUED GROWTH OPPORTUNITY

	SOYBEAN ROUNDUP READY	CORN ROUNDUP READY	CORN YIELDGUARD BORER	CORN YIELDGUARD ROOTWORM
Europe	1 million acres (400,000 Ha)	24 million acres (9.7m Ha)	8 million acres (3.2m Ha)	5 million acres (2 m Ha)

Source: *Monsanto, 2006i.*

3. the growing of gm crops in europe

Only one GM crop is grown commercially in the EU: Monsanto's MON810 maize. Although the biotechnology industry still has permission to grow two other GM crops - Syngenta's insect-resistant Bt176 maize and Bayer's T25 Liberty Link maize - market failure or safety concerns have ensured that these are no longer grown.

In the nine years of commercialization of GM crops, the industry has managed to persuade only Spain to grow GM maize on any significant scale. Due to weak monitoring by the Spanish government it is not clear how much GM maize is grown, but reports suggest that the cultivated area may have decreased for the second consecutive year, from around 57,000 hectares in 2005 to approximately 53,000 hectares in 2006 (Greenpeace, 2006c).

In 2006, the biotechnology industry once again struggled to get a foothold in Germany. Monsanto originally planned around 2,000 hectares of GM maize there, but following widespread protests only 950 hectares were planted on 40 farms (German Register of GM Cultivation). Out of a total of 370,000 farmers in Germany, 25,400 of them have founded 94 GMO-free regions comprising 877,000 hectares (Genechnick Freie Regionen in Deutschland, 2006).

Monsanto reportedly planted around 5,000 hectares of GM maize in France in 2006 (up from 1,000 hectares in 2005), but again there appears to be no official figures to confirm this (GMO Compass, 2006). The environment in France for GMOs remains hostile, with widespread protests and many uprooted fields. In addition, there have been reported increases in cultivated area in Portugal (up to 1249 hectares in 2006 from 780 hectares in 2005), although the number of GM-free zones has also increased to cover 14% of the country (Platforma Portuguesa por uma Agricultura Sustentavel, 2006). In addition, there has been a reported increase in cultivation in the Czech Republic, from 270 hectares in 2005 to 1290 hectares in 2006 (Farmers Weekly Interactive, 2006).

In short, although there have been small increases in the cultivation of GM maize in the EU, the amount is still a minuscule 1% of the total area of maize grown.

TABLE 4 GM MAIZE PRODUCTION IN THE EU

COUNTRY	TOTAL MAIZE PRODUCTION IN HECTARES (2005 FIGURE)*	REPORTED GM MAIZE 2006 IN HECTARES	% OF MAIZE CULTIVATION
Spain	422,100	53,000	12.5%
France	1,662,640	5,000	0.3%
Czech Republic	98,000	1,250	1.3%
Portugal	140,000	1,249	0.9%
Germany	443,100	950	0.2%
EU 2005	6,132,329	61,449	1.0%

Source: *FAOSTAT.*

3.1 accession countries

In 2007, Romania and Bulgaria will join the European Union. Both countries have previously grown GM crops, but they have now brought in measures to stop widespread cultivation.

Romania has officially cultivated Monsanto's Roundup Ready soy for several years. According to ISAAA figures, 70,000 hectares were grown in 2003 and 100,000 hectares in 2004 (James, 2003, 2004). Although the seeds are sold by Monsanto, there is also a large black market in seeds, making the situation largely unregulated and uncontrolled. Monsanto's GM soy is not permitted for cultivation in the EU, and in light of Romania's accession the government has banned the growing of Monsanto's seeds from 1 January 2007, despite the fact that Monsanto has applied for EU approval for the crop (Ministry of Agriculture, Romania, 2006). However, due to the black market, some quantities of GM soy will still be grown illegally in Romania. In a recent report, ISAAA, described Romania as one of its biotech "mega-countries" (James, 2005).

Although Bulgaria has not allowed commercial growing, it previously permitted the extensive cultivation of GM maize by Monsanto, Pioneer and Novartis for scientific purposes. However, in line with its EU accession plans, the government has reduced all major trials (Bulgarian Ministry of Agriculture and Forestry, 2004). Bulgaria has also brought in GMO laws that in places go beyond even EU regulations; for example, banning the genetic modification of all vegetables and fruits and placing 30 kilometer buffer zones around protected areas.

3.2 no public benefits

All of the food or feed crops thus far approved, and by far the majority pending approval, are genetically engineered to tolerate either broad spectrum herbicides or insect attacks. These products simplify weed and pest control in industrial agriculture, but offer no benefit to either the environment or consumers.

The GMO industry in Europe claims that genetic modification is "a tool for plant breeders developed over the past 30 years. [...] It enables new crop varieties to be produced with desirable traits not achievable using longer-established methods" (Europabio, 2005a). Given the industry's hype about its own potential, it is astonishing that it has only managed to bring two traits to the European market despite 30 years of research.

However, this may all change as companies attempt to break Europe's deadlock by promoting industrial crops such as BASF's GM potatoes, engineered to increase starch levels. In order to speed up its application, BASF has resorted to deleting from its application its original intentions to feed byproducts of the potatoes to animals. The current proposal is solely for industrial use.

3.3 can biotech save the world?

Previous arguments used in Europe to promote GM crops include "feeding the world", creating jobs, and improving Europe's competitiveness. Since the industry has failed to deliver on all three of these points, it is now looking to the next public relations exercise: this time, that GM crops are needed to save the planet! The GM industry in Europe is gearing up to promote the use of biotechnology to produce biofuels for transport uses. "Only with biotechnology can these renewable resources be produced efficiently and in sufficient amounts," according to industry adverts in major newspapers (Süddeutsche Zeitung, 2006). The fact that GM crops offer no advantage over conventional ones in the production of biofuels is absent from the industry's public relations drive.

4. barriers to monsanto's expansion plans

4.1 european public opinion

In 2006, an EU-wide survey of popular opinion confirmed the public's opposition to GM foods (Gaskell et al., 2006). The majority of Europeans think that GM food "should not be encouraged", and the survey concluded that "GM food is seen by them as not being useful, as morally unacceptable and as a risk for society".

Europeans are not anti-technology. The survey reported that "resistance to GM food is the exception rather than the rule. There is no evidence that opposition to GM food is a manifestation of a wider disenchantment with science and technology in general."

With a few exceptions, there has been a steady decline in support for GM food between 1996 and 1999, an increase between 1999 and 2002, and another decline from 2002 to 2005. The report states: "The decline between 2002 and 2005 is striking; in many countries levels of support drop below those reported in 1996. [...] In 2005, fewer people are prepared to discount the perceived risks of GM food against prospective benefits." For example, in 2005 support for GM food in Greece was only 12% (compared to 48% in 1996); in Germany it was 30% (compared to 56%); in the UK 48% (compared to 67%); and in France 29% (compared to 54%). This will be discouraging reading for the biotech industry.

Interestingly, the biotech industry is now attempting to undermine public opinion polls by doing its own research on consumer attitudes. In one EU-funded project, biotech companies question the validity of opinion polls and attempt to discover the "real attitudes" of European consumers about GM foods. Not surprisingly, a German biotech consultancy and Europabio are partners in the project (CORDIS, 2006).

4.2 national and regional bans

In 2006, all EU countries maintained their bans on GM crops. In November 2005, the people of Switzerland voted in a referendum to ban GM crops for the next five years. Over 55.7% of the public voted in favor of the moratorium to cover all of the country's 26 regions. In addition, numerous measures to reduce GM contamination have been agreed at the national and regional levels. Some regions, in Austria for example, have introduced strict rules that would make it virtually impossible to grow GM crops.

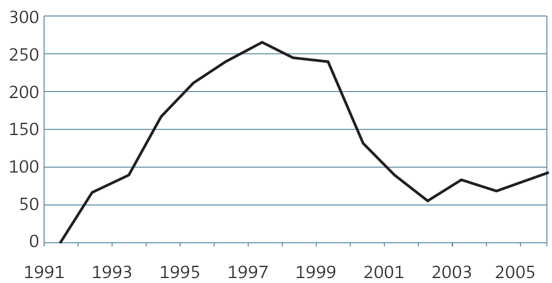
TABLE 5

COMPANY	GMO	BANNED IN:
Syngenta	Bt176 maize	Austria, Germany, Luxembourg
Bayer	Topas oilseed rape	France, Greece
Bayer	MS1xRf1 oilseed rape	France
Bayer	T25 maize	Austria
Monsanto	MON810 maize	Austria, Greece, Poland, Hungary

4.3 test site applications plummet

The number of applications to test GM crops in Europe has shrunk dramatically in recent years, although there was a slight increase in 2006. In 1997, the industry made over 260 notifications to test GM crops, but following public opposition this number has decreased to between 60 and 100 per year (Joint Research Centre, 2006). It is believed that this will have a major impact on the future development of GMOs in Europe.

FIGURE 1 **NOTIFICATIONS TO TEST GMOS IN THE EU**

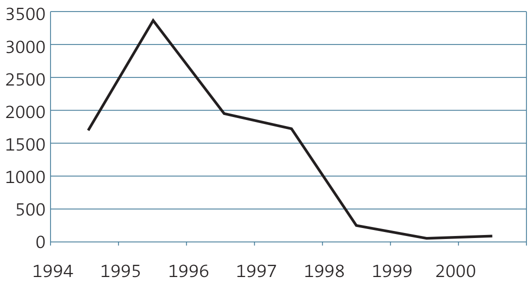


Source: *European Commission*

4.4 no markets

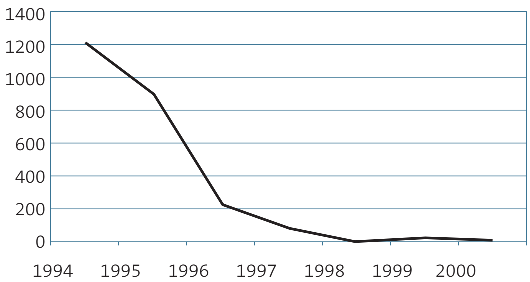
The introduction of GMOs in North and South America has had a major effect on these regions' agriculture trade with Europe. Canada, for example, has lost virtually all of its oilseed rape export market to Europe (replaced by Poland) since introducing GM oilseed rape. Similarly, the United States has lost its maize export markets (replaced by Argentina) over the same time period (Topfer International, 2006). As reported elsewhere in this report, the introduction of GM crops in many countries has exacerbated the disappearance of small farms and led to the increase of industrial-sized ones.

FIGURE 2 EU IMPORTS OF MAIZE FROM THE US



Source: *European Commission*

FIGURE 3 EU IMPORTS OF OILSEED RAPE FROM CANADA



Source: *European Commission*

Most recently, the US rice market has been destroyed, even though the country does not grow GM rice commercially. In August 2006, the US government announced that an experimental GMO from Bayer had contaminated US rice (USFDA, 2006a). Japan immediately banned all imports, and the EU introduced emergency measures that effectively halted all imports from the US. Because of the industry's inability to contain its experiments, US rice farmers have faced economic ruin, and a number of class action law suits have been filed against Bayer.

4.5 gm-free europe

In 2004, the European Commission commercialized Monsanto's MON810 seeds, making them available to farmers across the whole of the EU (European Commission, 2004). Instead of allowing Monsanto to increase its 'genetic footprint' in Europe however, this decision has instead generated a new movement against the cultivation of Monsanto's GM crops. Not only have a number of countries banned either the GMO itself or the Monsanto seeds, but a growing number of political regions and local governments have declared themselves entirely GM-free. This dramatic development has resulted in some countries where virtually every region has declared itself GM-free, including Austria, Greece and Poland. There are currently a total of 174 European regions and 4,500 local governments and smaller areas that have declared themselves GM-free (GMO-Free Europe).

5 conclusion

Europe has seen a remarkable backlash against the introduction of GM crops and foods. The public is solidly opposed to eating GM food, and a remarkable political movement exists against its cultivation. Although there have been marginal increases in the area grown, the long-term prospects for Monsanto's GM seeds look bleak. No markets, national bans, and evidence of environmental damage ensure that one of the world's biggest markets will remain a disaster zone for the biotech industry.

Despite this failure, however, the biotech industry still enjoys unquestionable support from some European institutions and member states that misguidedly view GM crops as an essential contribution to Europe's economic progress.

six new crops and the contamination paradigm

new crops and the contamination paradigm

Nnimmo Bassey, Friends of the Earth Nigeria
and Juan López Villar, Friends of the Earth International

1. introduction: new crops and contamination

Over the last decade of commercialization of genetically modified (GM) crops, only GM soy, maize and cotton have been commercially cultivated to any significant extent. However, although few GM crop species are legally marketed, the biotech industry and certain institutions have been experimenting with many other crops. Wheat, rice, potato, cassava and sorghum have all been or are currently in the development pipeline.

So far, a constant feature of the the release of GMOs into the environment - whether for experimental or commercial purposes - has been a lack of control once they are released. GM crops earmarked for animal feed contaminated the human food supply. GM crops that were supposed to be for experimental purposes appeared years later in the environment and the food supply. The extent of the contamination identified since 1996 clearly reflects that the biotech industry has pushed too far in the race for commercialization without understanding the implications or consequences.

2. corn

Corn was originally domesticated in Mesoamerica. Its production is the highest of all cereal grains in the world, ahead of wheat and rice, with over 690 million metric tonnes (MT) of production. Corn is primarily used as feed in the United States and Canada, but corn and cornmeal are staple foods in many regions of the world.

TABLE 1 TOP 10 CORN PRODUCERS IN THE WORLD IN 2005

RANK	COUNTRIES	PRODUCTION (IN METRIC TONNES, MT)
1	US	280,228,400
2	China	132,645,000
3	Brazil	34,859,600
4	Mexico	20,500,000
5	Argentina	19,500,000
6	India	14,500,000
7	France	13,226,000
8	Indonesia	12,013,710
9	South Africa	11,996,000
10	Italy	10,622,000

Source: *FAO, 2006c.*

There are several varieties of GM corn, mostly used as feed. One such animal feed variety, forbidden for human use, was at the center of the most infamous case of GM contamination in the last decade.

2.1 early lessons from contamination in the us: the starlink case

In 2000, Friends of the Earth United States discovered StarLink, a GM maize approved as animal feed, in the human food supply (FoEI, 2001). StarLink was not authorized for human consumption due to the potential allergenicity of Cry9C, a protein that was genetically engineered into the maize (FoE US, 2005). The magnitude and gravity of the StarLink contamination was breathtaking: more than 300 corn products were recalled across the United States. StarLink was only planted on 0.4% of total US corn acreage, but the number of acres contaminated was far greater.

Nor was StarLink contamination contained within the United States; in 2000 and 2001 StarLink was detected in food shipments to Japan and South Korea (FoEI, 2002). This led to a series of recalls in these countries, and an immediate decline in Japanese exports. "StarLink-free" certification was required for

corn exports to Japan, and inspectors there monitored and tested feed shipments (Segarra and Rawson, 2001). At the June 2002 United Nations World Food Summit in Rome, Latin American NGOs announced that StarLink had been found in US food aid in Bolivia. In February 2005, the presence of StarLink in Central American food aid was uncovered and denounced (Alianza Centroamericana de Protección a la Biodiversidad, 2005). Five years after its discovery in the human food chain, StarLink persisted, contradicting industry projections for full withdrawal within four years (Segarra and Rawson, 2001).

The StarLink case underlines the unpredictability of releasing a GMO into the environment, and the failure on the part of GMO developers to prevent contamination.

2.2 experimental transgenic bt10 corn contaminates food supply

Bt10 is a variety of GM corn that Syngenta developed for experimental purposes but never commercialized. However, in March 2005, it was discovered that Syngenta had accidentally distributed hundreds of tonnes of Bt10 to farmers between 2001 and 2004 (Nature, 2005a).

Syngenta initially claimed that Bt10 was identical to the previously approved Bt11 corn, but the company was later forced to admit that Bt10 contained a marker gene conferring resistance to ampicillin, a commonly used antibiotic (Nature, 2005b). The European Food Safety Authority (EFSA) has recommended that these types of antibiotic resistance markers "should not be present in genetically modified plants placed on the market" (EFSA, 2005b). Ampicillin is widely used to tackle infections of the middle ear, sinuses, bladder and kidneys as well as meningitis and other infections. The concern is that the consumption of Bt10 could cause bacteria in the stomach to pick up the gene conferring resistance to the antibiotic, making the bacteria less effective against infection (Bridges, 2005).

In the EU, it was discovered that approximately 1,000 metric tonnes of the unapproved corn strain had been imported from the US since 2001. Just as the Japanese had done with StarLink, the EU introduced stringent controls on US corn products, voting on 15 April 2005 to introduce emergency measures restricting the import of GM feed corn from the US. As a result, all imports must now be accompanied by certification that they are free of the illegal Bt10 corn strain (European Commission, 2005a). The measures require that "consignments of corn gluten feed and brewers grain from the USA can only be placed on the EU market if they are accompanied by an analytical report by an accredited laboratory which demonstrates, based on a suitable and validated method, that the product does not contain Bt10". Any ship originating from the US containing corn gluten feed or corn-derived brewers grain is obliged to provide an analytical report demonstrating that the product does not contain Bt10 maize (Syngenta, 2005).

Nonetheless, on 25 May 2005 the European Commission confirmed the presence of Bt10 in a US shipment of animal feed into Irish ports (European Commission, 2005b).

3. rice

Rice is the most consumed cereal grain on the planet, and is the staple food for more than half of the human population. About 80% of the world's rice is grown by small-scale farmers in developing countries (FAO, 2004b).

Over 400 million metric tonnes (MT) of rice were produced in 2005/06. Asia was the main producer, at around 370 million MT, followed by Latin America at around 15 million MT. The majority of rice produced is consumed domestically; only 28 million MT were exported during the period in question (USDA/ FAS, 2006b).

TABLE 2 **WORLD RICE PRODUCTION, TRADE AND USE IN METRIC TONNES**

WORLD BALANCE (MILLED BASIS)	2004/05	2005/06	2006/07
Production	408.5	421.2	424.2
Trade	29.4	28.5	28.2
Total utilization	415.1	418.5	420.6
Food	363.1	368.2	371.3
Ending Stocks	99.3	102.3	106.1

Source: *FAO, Food Outlook no. 1, June 2006.*

six new crops and the contamination paradigm

TABLE 4	TOP 8 WORLD RICE IMPORTERS (IN THOUSAND METRIC TONNES)			
IMPORTS	**2003**	**2004**	**2005**	**2006**
Philippines	1,300	1,100	1,890	1,900
Nigeria	1,448	1,369	1,777	1,600
Iran	900	950	950	1,200
Iraq	672	889	800	1,200
Saudi Arabia	1,150	1,500	1,250	1,000
EU-25	950	1,079	968	925
Malaysia	500	700	750	850
Ivory Coast	750	740	867	850
South Africa	725	818	850	800
Senegal	750	850	1,200	750
Bangladesh	1,112	801	785	700
China	258	1,122	609	700

Source: *USDA, 2006l.*

Asia is not only the chief producer but also the top importer of rice at an annual 7 million MT, followed closely by Africa. On a country basis, the biggest rice importer in the world is the Philippines with 1.9 million MT, followed by Nigeria with 1.7 million MT (USDA/ERS, 2006c, 2006l).

3.1 gm rice in the pipeline

In recent years, the biotech industry and scientists who support the technology have been trying to introduce GM rice for commercial purposes. After a decade of commercial planting of GM crops, however, the market for GM rice remains unreceptive. Experimental releases of GM rice have taken place around the world, and although two varieties of GM rice produced by the German biotech company Bayer have been approved in the United States, these lines have not been commercialized (USFDA, 2006a).

Nevertheless, the biotech industry has been stepping up the pressure to commercialize GM rice since 2005 by filing applications for approval of herbicide-tolerant "LLRice" in EU countries as well as in South Africa, Canada, and Brazil. The main crops genetically engineered so far - soybean, maize and cotton - are primarily destined for feed and/or industrial uses. Around 60% of maize production, for example, is devoted to feed use, and another significant percentage is for industrial uses such as starches, sweeteners and ethanol. In the United States it is estimated that ethanol manufacturing consumed around 20% of the 2006 maize crop (FAO, 2006b).

In contrast, rice remains essentially a food commodity, with only a small share of its global production destined for use as feed.

3.2 biotech industry provokes contamination of rice supply

The release of an experimental GM rice strain, Bayer's LL601, is at the center of one of the most recent contamination controversies. On 18 August 2006, the US Department of Agriculture (USDA) revealed that LL601, unapproved for human consumption, had contaminated commercial rice seed (Johanns, 2006). The statement did not reveal the extent of the contamination nor when or how it took place.

LL601 is engineered to withstand the herbicide glufosinate, and has not been approved anywhere in the world. It has not passed the US Food and Drug Administration's required safety review, nor the USDA assessment of its environmental impact (Center for Food Safety, 2006).

Bayer informed the USDA that the GM rice was "present in some samples of commercial rice seed at low levels" on 31 July 2006 (USFDA, 2006a). The rice was field tested between 1998 and 2001, and it is unclear how it could have contaminated later harvests. The company claims that it is not intending to commercialize LL601. But because it is now "in the marketplace" as a result of accidental contamination, Bayer has applied for US approval, which if granted would effectively limit liability on the company for the incident, and would make a mockery of any serious risk assessment procedures.

The international reactions to the announcement were negative. On 19 August, the Japanese Ministry of Agriculture, Forestry and Fisheries announced that its country was suspending US long-grain rice imports. Several days later, the EU adopted emergency measures requiring imports of long grain rice from the US to be certified as free from the unauthorized Bayer strain (European Commission, 2006a). In September, the first contamination case was reported in the Netherlands (Reuters, 2006a).

As a result of this backlash, rice prices dropped and farmers suffered substantial economic losses. It has been reported that Bayer, in response to a lawsuit by Missouri farmers, described the contamination as an "act of God" (Southeast Missourian, 2006).

3.3 friends of the earth africa monitors us food aid and commercial rice imports

The US exported more than 3 million metric tonnes (MT) of rice in 2005 (USDA/FAS, 2006). West Africa is the main destination for this exported rice, both commercially and as food aid. Ghana was the fifth largest importer of US rice in 2004/05, while Cameroon, Burkina Faso and Sierra Leone were among the top six recipients of rice as US food aid in 2005. As of July 2006, commercial imports of US long grain milled rice to Ghana totalled 3,500 MT, followed by Liberia with 1,200 MT, Lybia with 300 MT, and Nigeria and Egypt with 100 MT (USDA, 2006).

In the light of the contamination in Europe and Japan, Friends of the Earth Africa decided to monitor rice imported from the US in September 2006.

TABLE 5 TOP 10 US RICE EXPORT MARKETS (IN THOUSAND METRIC TONNES)

RANK	2004/05		2003/04	
	COUNTRY	EXPORTS	COUNTRY	EXPORTS
1	Mexico	522.1	Mexico	1,900
2	Japan	352.4	Japan	1,600
3	Haiti	258.8	Haiti	1,200
4	Canada	232.0	Canada	1,200
5	Ghana	166.4	Cuba	1,000
6	Nicaragua	130.7	Brazil	925
7	Costa Rica	127.1	Philippines	850
8	Turkey	125.8	Costa Rica	850
9	Iraq	123.6	Honduras	800
10	Cuba	122.3	Saudi Arabia	750
	Sub-total	2,161.1	**Sub-total**	700
	Total exports	3,542.2	**Total exports**	700

Source: *Foreign Agricultural Service, USDA.*

TABLE 6 MAIN RECIPIENTS OF US FOOD AID AS RICE (IN THOUSAND METRIC TONNES)

RECIPIENTS	2005
Philippines	63.5
Honduras	12.9
Burkina Faso	12
Cameroon	11
Indonesia	9.3
Sierra Leone	6.5
Madagascar	6
Sri Lanka	5.7
Nicaragua	3.9

Source: *USDA/FAS, 2005.*

A round of monitoring activities was undertaken in Ghana and Sierra Leone by Friends of the Earth local chapters. Collected samples, sent to an independent laboratory in the United States, confirmed the presence of the illegal GM rice LL601 in nine samples. In Sierra Leone, two bags of US food aid and one commercial rice product were tainted. In Ghana, six different types of commercial rice from the US, including brands such as Gold Rush, Texas Stars and Chicago Stars, also tested positive (FoE Africa, 2006b).

TABLE 7 **US RICE PRODUCTS CONTAINING ILLEGAL GM RICE DETECTED BY FOE AFRICA MONITORING ACTIVITIES IN SEPTEMBER 2006**

NO.	COUNTRY	PRODUCT
1	Sierra Leone	Long Grain Rice, food aid from USAID
2	Sierra Leone	Long Grain USA, Milled Rice, food aid from USAID
3	Ghana	Texas Stars Rice Special Selection
4	Ghana	Gold Rush, Special Christmas Quality, Long Grain Ricemaster's Choice
5	Ghana	Chicago Stars American Long Grain Rice
6	Ghana	First Choice American Long Grain Rice, Hard Milled, White Rice
7	Ghana	Texas Star American Long Grain Rice, Hard Milled, White Rice
8	Ghana	Bronco American Long Grain Rice, Hard Milled White Rice
9	Sierra Leone	Big Brother, Long Grain/ USA

Source: *FoE Africa, 2006b.*

3.4 credibility of us regulatory system further eroded

Friends of the Earth Africa revealed the contamination of Bayer's GM rice on the morning of 24 November (FoE Africa, 2006a). On the evening of that same day, the experimental rice strain was commercially approved by the US Department of Agriculture (USDA, 2006p).

The USDA decision was surprising. The LL601 rice had only been released for experimental purposes, and the developer, Bayer CropScience, had abandoned plans to commercialize the variety five years earlier. The US-based Center for Food Safety has strongly condemned USDA's decision, arguing that exhaustive testing was not carried out and that there is no guarantee that the GM rice is not a human health or environmental hazard (Center for Food Safety, 2006b). According to the Washington Post, Center for Food Safety Director Joe Mendelson said: "The quick approval shows that the USDA is more concerned about the fortunes of the biotechnology industry than about consumers' health" (Washington Post, 2006).

3.5 us rice federation's plan of action to remove gmos from the rice supply

Within a few days of the USDA decision to consider LL601 safe, the US Rice Federation had recommended a plan of action to remove GM rice from US seed supplies in order to re-establish a marketable stock (Delta Farm Press, 2006; USA Rice Federation, 2006). The plan requests state authorities to take specific actions to ensure that commercial rice seed supplies for the 2007 crop test negatively for all Liberty Link GM traits.

3.6 more gm contamination found in chinese products

The LL601 scandal was not the only blight to GM rice. A new contamination case also occurred on 5 September, when food products containing experimental GM rice from China were discovered by Friends of the Earth and Greenpeace in Asian stores in the UK, France and Germany (Friends of the Earth Europe, 2006).

The foods tested were bought from Asian stores in Germany, France and the UK. The products testing positive were: Cock Brand Rice Sticks (France), Swallow Sailing Rice Sticks (Germany), Brotherhood Rice Vermicelli (UK), Happiness Rice Vermicelli (UK), and Gold Plum Rice Sticks (UK).

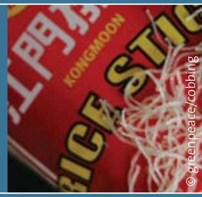

©greenpeace/cobbing

TABLE 8 PRODUCTS ORIGINATING FROM CHINA FOUND CONTAMINATED WITH GM RICE

COUNTRY	PRODUCT	IMPORTER
France	Rice sticks	Tang Brothers
Germany	Rice sticks	Heuschen &Schrouff
UK	Guangdong rice vermicelli	SeeWoo Foods Ltd
	Rice vermicelli Amoy (Xiamen)	SeeWoo Foods Ltd
	Kongmoon rice stick	Packed for Double Happiness

Source: *Friends of the Earth International and Greenpeace.*

This incident may have stemmed from field trials in China. No GM rice had yet been commercialized there, although a 2005 investigation by Greenpeace found that research institutes and seed companies in the country were illegally selling unapproved GM rice seeds to farmers. Further testing indicated that the whole food chain had been contaminated, with the most recent case being contaminated Heinz rice cereal products in Beijing, Guangzhou and Hong Kong. In the wake of the situation, the Chinese government reportedly punished seed companies and destroyed illegally grown GM rice (Greenpeace, 2006b).

The illegal rice in question is an experimental variety genetically engineered to produce an insecticide. It is not approved for human consumption or commercial cultivation anywhere in the world. Scientific studies have raised concerns about the risks of eating this GM rice, in particular its potential to cause food allergies. The rice contains either the Cry1Ac protein or a fusion Cry1Ab/Cry1Ac protein; a 1999 study partly funded by the US Environmental Protection Agency found evidence to suggest that the Bt protein Cry1Ac elicits antibody responses consistent with allergic reactions in farmworkers (Benstein et al., 1999), while a series of studies published in 1999 and 2000 by a team of scientists led by Cuban researcher Vasquez-Padron documented immunogenic responses to on Cry1Ac that indicate the potential for allergic reactions or other immune system responses (Vázquez-Padrón et al., 1999a, b, 2000; FoEI, 2003).

4. wheat

Wheat is another of the most important and widely produced food grains for human consumption. It is a cereal crop used to make, among other things, flour, bread, cake, pasta, couscous, beer and other alcohols.

TABLE 9 TOP PRODUCERS OF WHEAT IN THE WORLD, 2005

RANK	COUNTRIES	PRODUCTION (IN METRIC TONNES, MT)
1	China	96,340,250
2	India	72,000,000
3	US	57,105,550
4	Russian Federation	47,608,000
5	France	36,922,000
6	Canada	25,546,900
7	Australia	24,067,000
8	Germany	23,578,000
9	Pakistan	21,591,400
10	Turkey	21,000,000

Source: *FAO, 2006c.*

4.1 monsanto defers plan to commercialize gm wheat

Monsanto started field testing its GM wheat in 1997, and in December 2002 the company petitioned for the legal cultivation of its Roundup Ready (RR) wheat in the US and Canada. Together with several US universities, Monsanto agreed to develop and bring to market a RR hard red spring wheat in 2003 (Center for Food Safety, 2003). Meanwhile, these plans to release GM wheat for commercial purposes were facing growing opposition worldwide from farmers, food manufacturers, environmentalists and consumers. In May 2004, Monsanto announced that it was "deferring all further efforts to introduce Roundup Ready wheat, until such time that other wheat biotechnology traits are introduced" (Monsanto, 2004c).

six new crops and the contamination paradigm

5. biopharmaceutical crops

'Biopharming' is an experimental application of biotechnology in which plants are genetically engineered to produce pharmaceutical proteins and chemicals that they do not naturally produce (FoE US, 2004). Examples include a contraceptive, potent growth hormones, a blood clotting agent, blood thinners, industrial enzymes, and vaccines.

In November 2002, the first significant case of contamination by biopharmaceuticals was reported in the US (FoE US, 2000). ProdiGene, the company involved, conducted a range of open-air tests of crops containing pharmaceuticals and industrial products. In 2002, the company failed to remove all of the maize remnants from one of its cultivated fields, and the leftover 'volunteer' seed germinated in 2003, contaminating a crop of soy. The contamination was discovered when the harvested soy had been taken to a grain elevator in Nebraska. Five hundred thousand bushels of soy worth around $2.7 million were quarantined by the US Department of Agriculture and were later destroyed.

It should take no more than this one case to prove that open-air cultivation of biopharmaceutical crops threatens global food supplies, jeopardizes non-biopharm crops with contamination, and poses potential problems for wildlife and ecosystems, not to mention human health. In the US, some 300 cases of open-air cultivation have occurred between 1991 to 2002, but only seven environmental assessments have been carried out.

"In the absence of demonstrated effective controls and procedures to ensure against any contamination of the food or feed supply, National Food Processors Association (NFPA) vigorously opposes the use of food or feed crops to produce plant made pharmaceuticals."

Dr. Rhona Applebaum, NFPA's Executive Vice President and Chief Science Officer.

Strong opposition from consumer groups, the food industry, and a growing number of scientists can be credited for the drop from a peak of 42 field trials in the US in 2000 to just 6 in 2003 (Nature Biotechnology, 2005). In April 2005, plans to introduce biopharm rice in Missouri were abandoned due to the opposition of Anheuser-Busch, the world's largest beer maker (St. Louis Post-Dispatch, 2005). Nevertheless, BIO, the umbrella organization of the US biotech industry, still supports the development of these crops (BIO, 2005) despite the demonstrated contamination risks and the failure of plant-based 'biopharming' to deliver even one FDA-approved drug over the past 14 years.

6. biofuels

6.1 the growing interest in biofuel production

Throughout 2006, biofuels constantly appeared in the media in the context of the current energy debate. This has been particularly prominent in North America, where biofuels are often presented as a "panacea" to the current oil "addiction" (NBC, 2006; CBS, 2006). The lobby for the increased use of biofuels in the US has gained the support of President Bush, who has positioned biofuels to replace more than 75% of US oil imports from the Middle East by 2025 (BIO, 2006a).

Biofuels and industrial biotechnology - also called the "third wave of biotechnology" - constitute a key strategic sector for the biotech industry. The biotechnology industry welcomed President Bush's support, and said that "the biotechnology industry can play a vital role in meeting the President's stated goal of increasing America's energy security by replacing imported oil with domestically produced alternative fuels" (BIO, 2006b).

The interest in biofuels has also sprung up in other parts of the world. Strategies to promote large-scale biofuel and biomass use have been launched in the EU (European Commission, 2006d), as well as in developing countries including Senegal and India.

The increase in the use of biofuels may go hand in hand with an increase in the planting of GM crops and the development of new biotechnology applications. Applications for a new variety of GM maize to be used for ethanol have already been filed in the US, China, the EU and South Africa. In addition, current GM crops such as soy may be used to make soybean-oil derived biodiesel in countries including Brazil (USDA/ERS, 2006b).

6.2. biotechnology developments specifically for biofuels

The use of biotechnology specifically for energy use falls into two categories. The first is the genetic modification of crops such as corn to reduce the cost or increase the efficiency of ethanol production. Syngenta has progressed furthest in this area, and the company has recently applied for USDA approval

of its 3272 line of corn, genetically modified to contain an enzyme (thermostabile alpha-amylase) used in the ethanol production process (Nature Biotechnology, 2005b).

Syngenta has also applied for import clearance of GM corn 3272 in the EU, China and South Africa. At present, enzymes produced in bacteria are added during the corn-to-ethanol process. The enzyme generated in Syngenta's GM corn is derived from a deep-sea bacterium, and is claimed to be superior to currently employed enzymes by virtue of its heat stability and its higher activity at the acidic pH of the ethanol production process. It should be noted that this very same enzyme is currently being marketed by Diversa, a company in which Syngenta owns a major stake, raising the question of whether this maize is even needed (Nature Biotechnology, 2005b).

Other GM corn varieties under development would contain higher levels of starch, which would allegedly provide higher yields in ethanol production. However, concerns about Syngenta's 3272 line include the potential allergenicity of its novel enzyme, the heat stabile alpha-amylase, fungal versions of which are known to cause occupational allergies.

In the future, it is hoped that biotechnology will make it economically feasible to convert crop waste or switchgrass, which consists largely of cellulose, into ethanol. It is estimated that it will take 10 to 15 years of research and development to achieve a cost-effective conversion of cellulosic biomass into ethanol (Natural Resources Defense Council/Union of Concerned Scientists, 2004). This process involves the use of genetically modified bacteria to generate three different types of 'cellulase', the class of enzymes that break down cellulose into fermentable sugars that can then, like the starch and sugars of currently used corn grain and sugarcane, be converted to ethanol (BIO, 2006a).

While the use of crop residues for ethanol production is preferable to the use of dedicated energy crops, there are real questions about whether technical obstacles to cost-effective conversion will be overcome. It is also important to examine the current uses of crop 'wastes' and assess how diversion to ethanol production would affect them. For instance, corn stover (the stalks and leaves) are often plowed back into the soil, providing a source of organic matter that may be lacking in soils depleted by intensive industrial cultivation practices. To what extent will diversion of corn stover to cellulosic ethanol further deplete already deficient soils? The few studies conducted in this area suggest that diverting any more than roughly one-third of crop waste to ethanol production could badly impair soil quality.

Crop waste is also used as silage for animal feed, although in the case of corn, the corn stover is normally silaged together with the associated corn grain of corn plants grown specifically for this purpose. In many parts of the world, the 'waste' from processed sugarcane (called 'bagasse') is burned to fuel sugarcane processing. Any analysis of cellulosic ethanol from sugarcane waste would have to assess the impacts (both environmental and socio-economic, and both positive and negative) of diverting bagasse from this important use to ethanol production. Other potential sources of cellulosic biomass include wood chips.

While no one knows for sure how long will take to develop such technologies, some predictions indicate a minimum of five years (USDA/ERS, 2006h), while others estimate 10 to 15 years. In his January 2006 State of the Union Address, President Bush said: "Our goal is to make this new kind of ethanol practical and competitive within six years." In order to support this research, the President is requesting $150 million in the 2006 budget, an increase of $59 million (US Department of Energy, 2006a). With the new funding, it is expected that ethanol feedstocks such as wood chips, corn stover and switchgrass will be cost-competitive by 2012 (US Department of Energy, 2006b).

6.3 gm not better than conventional

Existing GM corn varieties offer no known advantage over conventional corn for ethanol production. While there are currently no GM corn varieties modified specifically for this purpose, some "highly fermentable" corn hybrids (which may be either GM or conventional) happen to be more suitable due to higher than average levels of starch. Various companies have identified such lines in their offerings, and are advertising them specifically for ethanol production (Patricio, 2006). For example, the Pioneer Industry Select program marketed 135 corn hybrids in 2006 for this use (PR Newswire Association LLC, 2006).

six new crops and the contamination paradigm

7. gm bentgrass for golf courses

Monsanto and the Scotts Miracle-Gro Company are developing a genetically modified variety of grass that can tolerate Roundup herbicide, with the aim that Roundup can be sprayed to kill weeds without killing grass in places like golf courses (The New York Times, 2004).

Bentgrass is a perennial, and its pollen is so small that the wind can carry it over long distances. Taking into account the difficulty of controlling bentgrass - since it does not have to be replanted every year, and has wild relatives - the USDA began a full-scale environmental impact assessment in 2004. This was the first time that the USDA subjected a genetically modified plant to such intense scrutiny.

In 2006, although the GM variety of grass was not yet approved, it was reported that an unapproved type of grass had been found in the wild by Environmental Protection Agency scientists. The unauthorized grass was found in Oregon, near the site of field tests that had taken place years before.

At the time this publication went to print, the USDA had no timetable for a decision on this GM plant (The New York Times, 2006b).

TABLE 10 TOP PRODUCERS OF CASSAVA IN THE WORLD, 2005

RANK	COUNTRIES	PRODUCTION (IN METRIC TONNES, MT)
1	Nigeria	38,179,000
2	Brazil	26,644,700
3	Thailand	19,459,400
4	Indonesia	16,938,000
5	Democratic Republic of Congo	14,974,470
6	Ghana	9,738,812
7	Angola	8,606,210
8	Tanzania	7,000,000
9	India	6,700,000
10	Mozambique	6,150,000

Source: *FAO, 2006c.*

8. cassava

8.1 the food security crop

Cassava, a root crop, also known as Manihot esculenta, is the staple food for approximately 600 million people in Africa, Asia and Latin America (SciDev, 2006). Cassava is planted on around 16 million hectares around the world, with 50% of that area in Africa, 30% in Asia, and 20% in Latin America (FoE Africa, 2006c).

Nigeria is the top producer in the world, with over 35 million metric tonnes per year, followed by Brazil and Thailand. Six out of 10 of the top world producers are in Africa (FAO, 2006c).

The crop is both versatile and valuable. Its leaves and tubers (roots) are used for food, while its stems are the planting material. Because of its hardy nature and ability to survive in harsh weather and soil conditions, cassava is a major food security crop for Africa. It does well even in poor soils, greatly reducing the economic pressure on poor farmers to purchase artificial fertilizer (Africancrops, 2006).

Cassava can also produce high yields, and as its tubers are stored underground they can be harvested when needed. Not only is the crop valuable as food and feed, but pharmaceutical companies also use it to produce glucose and sugar dextrose (Baguma, 2006). There is also a push for the growing of cassava for ethanol production as the interest in biofuel rises (Edukugho, 2006).

8.2 experiments to genetically modify cassava

Research into the genetic manipulation of cassava has been ongoing since the mid-1990s (SciDev, 2006b). The targets of the modifications include the cyanogen content, (Ohio State Research News); the storage potential; the mosaic virus; and the cassava's starch yield. Another reason for modification given by proponents is that GM cassava would "potentially help improve the nourishment of millions" (FAO, 1995). However, as with other such claims, the practical potential of GM cassava to become more nutritious is highly debatable. Equally, the cyanogen content of cassava is not a major problem; its 'bitterness' is even a form of natural protection against insects, rats and monkeys, while the poisonous varieties have the advantage of higher yields because they are less susceptible to pests (Zweifel, 1992).

8.3 gm cassava experiment fails in nigeria

In Nigeria, the world's foremost producer of cassava, an application for a "contained" field trial of GM cassava was submitted to the Federal Ministry of Environment in 2004 by the International Institute for Tropical Agriculture (IITA), the National Biotechnology Development Agency (NABDA), the National Root Crops Research Institute, and the Donald Danforth Plant Science Center in St. Louis, Missouri.

The cassava clones developed for resistance to mosaic disease were subsequently created at the Danforth Center (USDA, 2006m). Monsanto has been a primary donor in establishing this Centre, and has recently received a $15 million dollar grant from the Monsanto Fund (St. Louis Dispatch, 2006).

When the experiment failed to confer resistance against cassava mosaic disease, the IITA asked the Nigerian Ministry of Environment to cancel the application. Friends of the Earth Nigeria wrote to the Ministry for clarification on the status of the GM cassava application (ERA/FoE Nigeria, 2006b); in response, the Ministry confirmed that the application had been "withdrawn by the IITA because according to the applicants some cassava plants derived from the original transgenic lines (Y85 and Y44) showed signs of methylation in the promoter, thereby suppressing resistance has diminished" (Nigerian Ministry of Environment, 2006).

9. sweet potato

Sweet potato is a root crop native to the tropical Americas. It is typically grown by small farmers, often cultivated in marginal soils with low output. The production is concentrated in countries with low per capita incomes. More than 95% of its global production occurs in the developing world, and it is produced in more than 100 tropical countries. According to the Centro Internacional de la Papa, sweet potato "ranks as the fifth most important food crop on a fresh-weight basis in developing countries, after rice, wheat, maize, and cassava" (Centro Internacional de la Papa).

9.1 sweet potato trial fails in kenya

Sweet potato has been the target of genetic engineering efforts in Africa. Florence Wambugu, a two-time Monsanto Company "Outstanding Performance Award" winner and author and publisher of the book Modifying Africa: How Biotechnology Can Benefit the Poor and Hungry, has been an instrumental player in biotechnology's thrust into Kenya. Wambugu was also the first director of ISAAA's AfriCentre, which was established in 1994 and has been promoting GM sweet potato in Africa (ISAAA Africenter). In January 2002, Wambugu established her own institution, becoming chief executive of Africa Harvest Biotech Foundation International (AHBFI). AHBFI's communications program is supported by CropLife International, an organization led by companies such as BASF, Bayer, Dow, DuPont, Monsanto and Syngenta.

The cornerstone of Florence Wambugu's career has been Monsanto and USAID's GM sweet potato project, which she adopted as her own. In July 2003, the Toronto Globe & Mail reported her as saying that feathery mottle virus resistant GM sweet potatoes can achieve yields of 10 tonnes per hectare (compared with a natural Kenyan sweet potato yield of 4 tonnes per hectare). There was a flurry of press activity on the resounding success of Wambugu's GM sweet potato, but by early 2004 there was no way of knowing the actual yields, as no peer-reviewed reports or official figures were published during the three years of trials in Kenya. Nevertheless, these trials were

TABLE 11 TOP 10 PRODUCERS OF SWEET POTATO IN THE WORLD, 2005

RANK	COUNTRIES	PRODUCTION (IN METRIC TONNES, MT)
1	China	10,752,430
2	Uganda	2,650,000
3	Nigeria	2,516,000
4	Indonesia	1,840,248
5	Vietnam	1,550,000
6	Japan	1,050,000
7	Tanzania	970
8	India	900
9	Rwanda	885,648
10	Burundi	834,394

Source: *FAO, 2006c.*

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presented by Wambugu and picked up by the media as an agricultural revolution in Africa: "Millions Served: Florence Wambugu Feeds her Country with Food Others have the Luxury to Avoid" (Forbes, 2002).

However, at the end of January 2004, more than US$10 million later, the results of the trials were quietly published in Kenya, showing that none of her claims were true. Kenya's Daily Nation reported: "Trials to develop a virus-resistant sweet potato through biotechnology have failed. US biotechnology, imported three years ago, has failed to improve Kenya's sweet potato" (Kenyan Daily Nation, 2004). Indeed, the results revealed that the non-GM sweet potatoes tested had significantly higher yields than the GM variety. New Scientist also reported the project's failure as "Monsanto's Showcase Project in Africa Fails" (New Scientist, 2004). It emerged that sweet potato feathery mottle virus was not a primary constraint on sweet potato production, nor was it a significant cause of food insecurity, let alone famine.

Instead of recognizing the failure, Wambugu's AHBFI bluntly states on its website that "Africa Harvest has exited the project to concentrate on other priorities in the fight against hunger" (AHBFI, 2006).

10. sorghum

Sorghum belongs to the family of grasses raised for grain. Originating in tropical and subtropical regions of East Africa, it a drought-resistant, heat-tolerant species. Globally, sorghum is primarily used as a food grain for humans, and can be ground into flour and used to make pancakes, porridge and flatbreads. In the US, however, sorghum is mainly used as feedstock (Celiac Sprue Association, 2004).

According to USDA estimates, Nigeria is the biggest sorghum producer in the world, with over 10 million metric tonnes in 2005/06, followed by the US, India, Mexico and Ethiopia. Very little sorghum is traded around the world, but the US is the top trader with over 90% of total world exports (USDA, 2006l).

10.1 south africa halts plans to genetically modify sorghum

The Africa Harvest Biotech Foundation International, headed by Florence Wambugu, secured US$18.6 million for five years from the Bill & Melinda Gates Foundation to develop new sorghum varieties with higher levels of iron, zinc and vitamins. The organizations together applied to set up a laboratory for greenhouse trials in South Africa, but in July 2006 the South African authorities rejected the application due to concerns that GM sorghum could contaminate wild varieties (SciDev, 2006c).

TABLE 12 PRODUCTION AND EXPORTS OF SORGHUM 2005/06

COUNTRIES	PRODUCTION (IN METRIC TONNES, MT)	EXPORT
Nigeria	10,500,000	50
United States	10,005,000	5000
India	7,790,000	25
Mexico	5,500,000	-
Ethiopia	2,800,000	-
China	2,546,000	25
Argentina	2,200,000	250
Australia	2,019,000	200
Burkina Faso	1,837,000	-
World total	59,164,000	5626

Source: *Friends of the Earth International based on USDA data, 2006l.*

11. potato

Potato is a tuber crop that originates in South America, where it has been consumed for more than 8,000 years. It is the fourth most important food crop in the world, and its annual production is estimated at around 300 million tonnes (Centro Internacional de la Papa, b).

11.1 attempts to genetically modify potato

To date, no GM potatoes have been commercialized on a significant scale anywhere in the world. Monsanto has developed GM varieties to kill the Colorado beetle, but these were withdrawn from the US market in 1999 (ERS, 2005). The release of GM potato varieties also failed in Georgia and the Ukraine, and attempts to release it in Bolivia were foiled.

TABLE 13 **TOP PRODUCERS OF POTATO IN THE WORLD, 2005**

RANK	COUNTRIES	PRODUCTION (IN METRIC TONNES, MT)
1	China	73,036,500
2	Russian Federation	36,400,000
3	India	25,000,000
4	Ukraine	19,480,000
5	United States	19,111,030
6	Germany	11,157,500
7	Poland	11,009,390
8	Belarus	8,185,000
9	Netherlands	6,835,985
10	France	6,347,000

Source: *FAO, 2006c.*

11.1.1 potato commercialization fails in georgia and the ukraine

Georgia and the Ukraine intended to commercialize GM potatoes as early as 1996. In May of that year, between 133 and 148 tonnes of Monsanto's "NewLeaf" GM potatoes were imported from the US and Canada into Georgia, where they were planted in traditional potato-growing regions. However, cultivation of the potatoes failed, leading to commercial losses and debts for the farmers involved. The 1996 harvest was extremely low: instead of the estimated 18-22 tonnes per hectare, farmers only harvested around 8 tonnes per hectare. Official reasons given for the failure were that the biotech potatoes were not adapted to local conditions, that the planting was done too late, and that the potatoes were affected by the phytophthora fungus (FoEI, 2004).

11.1.2 trials in bolivia blocked

Bolivia is a center of origin for the potato. Farmers in the high Andean region ensure their food needs through the diversification of agriculture and the benefits of biodiversity. The potato is a basic component in ensuring food sovereignty for Bolivian farming families and for the country itself.

In April 2000, the Bolivian Biosafety Committee approved a request for field trials of a GM potato resistant to nematode worms. The request was presented by the Bolivian Proinpa Foundation, with material originating from Leeds University in England.

However, genetic contamination of non-GM varieties by GM potatoes would seriously impact biodiversity and cultural diversity in Bolivia, and could also cause genetic erosion, the disappearance of some varieties, and the loss of traditional cultural practices connected with the potato.

As a result, the Proinpa Foundation came under heavy criticism at several public meetings in La Paz, Cochabamba and Sucre, Bolivia. In June 2000, Proinpa withdrew its GM potato field trials project due to the "debate that GM potatoes were generating in the country" and with "the aim to create a better moment for doing so" (FoEI, 2004).

11.2 basf's new gm potato

An application to the EU for the cultivation of a GM potato was also made by the Swedish company Amylogene, since taken over by Germany's BASF. The potato, termed EH92-527-1, has been engineered to increase production of amylopectin, a key component for starch production (EFSA, 2005). In the first vote between EU states in eight years for a GM crop for cultivation, the industry failed to gather enough votes for its introduction. In the meantime, some starch companies have publicly stated that they will not be buying these potatoes if they are grown. As of December 2006, the EU had not taken a decision about this genetically modified potato.

seven conclusion

conclusion

1. gm crops fail to deliver benefits

The experience of the last 11 years of commercialization of GM crops provides us with enough material to make a first analysis of the technology's global performance and to answer the key questions: what are the benefits of GM crops, and who reaps them? This report has analyzed a substantial amount of documentation from scientific technical bodies, industry, academia, governments, and civil society from around the globe, and concludes that a decade of worldwide commercialization of GM crops and increased penetration of GM crops in a few countries has failed to deliver the benefits that its proponents claim.

Eight main conclusions arise from this report:

The GM crops commercialized on a large scale in a few countries in the world since 1996 have not addressed the main agricultural problems and challenges facing farmers in most countries of the world, and have not proven to be superior to conventional crops. Despite Paraguay and Brazil's massive adoption of GM soy, farmers in those countries are still in deep crisis, and production has gone down in the last two years due to low prices and increased costs for inputs, such as transgenic seeds. GM cotton farmers in South Africa, Colombia, Argentina, Mexico, and Australia have been severely affected by low prices and weather conditions like drought. GM cotton has not contributed meaningfully to their livelihoods, and the crisis of the cotton sectors in those countries has continued despite the introduction of GM cotton. Bt cotton does not address the key challenges facing Indian cotton farmers, including drought, the rising costs of inputs, falling cotton prices, and mounting debt. Consequently, a large number of small-scale cotton farmers in the country are trapped in poverty and indebtedness. In short, GM crops have contributed little if anything towards addressing the major challenges faced by farmers in most countries.

GM crops have been released quickly and widely without an adequate evaluation and understanding of their performance or of their health, environmental and socio-economic impacts. The discovery of GM rice in the food chain in the US, Europe, Africa and Asia, stemming from experimental trials in the US that were supposed to have ended in 2001, shows the inability or unwillingness of the industry to control its products. The increased susceptibility of GM soy to drought went unheeded in Brazil and Paraguay, where farmers suffered greatly from the huge losses in their GM soy harvests due to recent droughts.

The rapid introduction of GM cotton has caused severe problems with herbicide-resistant weeds (United States), poor performance (India and Indonesia), and secondary pests not killed by Bt cotton (China). For instance, the introduction of inferior Bt cotton varieties in India's Andhra Pradesh, ultimately banned due to poor performance, illustrates the hazards of the premature, profit-driven adoption of poorly-tested GM crops. The belated 'fix' that is only now being suggested to remedy Bt cotton's recent failures in China - the planting of refuges to stave off future insect attacks - vividly demonstrates the lack of foresight in those promoting transgenic technologies.

Small-scale farmers and consumers have not benefited from the introduction of GM crops. GM crops have not improved the livelihoods of small farmers in a sustainable manner. On the contrary, data from across the world demonstrates that GM crops have often performed worse than conventional varieties in countries including India, Indonesia, Brazil and Paraguay. In recent years, small farmers in China have earned more planting conventional cotton than the Bt variety. In India and Indonesia, many small farmers have suffered from the agronomic failure of Bt cotton. In South America, GM crops have contributed to the further concentration of land and the displacement of small-scale farmers. No GM product commercialized today offers any benefits to the consumer in terms of quality or price. GM feed does not even offer an advantage to the feed industry.

GM crops commercialized today have on the whole increased rather than decreased pesticide use, and do not yield more than conventional varieties. The environment has not benefited, and GM crops will become increasingly unsustainable over the medium to long term. Data from the United States, Australia and Brazil indicates that GM crops do not yield more than comparable conventional varieties. Even the US Department of Agriculture has recognized this fact. Comprehensive and independent analysis from the US, and indications from countries such as South Africa and Brazil, indicate that GM crops do not reduce pesticide use, and may even lead to increased chemical use for some GM varieties. With the appearance of pest and weed resistance, the unsustainability of the GM crop model will increase in the medium to long term. Further soybean expansion in South America will increase deforestation in critical areas such as the Amazon, leading to the displacement of poor rural families and a reduction in food security as crops for domestic consumption are replaced by export-oriented soybean monocultures.

To date, GM crops have done nothing to alleviate hunger or poverty. The great majority of GM crops cultivated today are used as high-priced animal feed to supply rich nations with meat. More than four out of every five hectares of GM crops are engineered to withstand the application of proprietary herbicides sold by the same company that markets the GM seed, and have little if any relevance to farmers in developing countries who often cannot afford to buy these chemicals. The experience with Bt cotton in South Africa, the most widely-touted example of a small-scale farmer success story; the ongoing fights in India over pricing and the agronomic failures of Bt cotton; the recent reports documenting the losses suffered by Bt cotton farmers in China; the inability of Bt cotton to address the main problems of small-scale cotton farmers in India; all of these cases strongly suggest that GM crops are not an effective tool for addressing hunger and poverty. Yet despite these failures, charitable groups like the Gates Foundation are funding transgenic plant research that is very unlikely to yield any significant benefits to the world's small farmers.

Monsanto has been the main beneficiary of the commercialization of GM crops in the United States. Through constantly acquiring new seed companies, Monsanto has gained enormous control over the world seed business, creating a platform for the widespread introduction of its GM traits into exorbitantly priced seed. Further 'monopolistic' consolidation of that trend in the US will further reduce choices for farmers and consumers, and will likely lead to the disappearance of conventional - non genetically-modified - varieties of seed for key crops like cotton, soybeans and maize. Monsanto's strategy is to "increase penetration" of its GM crops in the key strategic markets: GM soybeans in Brazil, GM cotton in India and Africa, and GM corn in the United States and Europe. However, the soybean crisis in Brazil, the current controversy over GM crops in India, and continued market opposition to GM food in Europe have all forced the company to lower its expectations.

Large-scale farmers in the US and Argentina have benefited from a 'convenience effect', particularly in soybean production. However, it is questionable whether this 'convenience effect' means greater net economic returns compared to those derived from conventional soybean production. Large-scale farmers in the US and Argentina, who represent a small minority of the world's farmers, are the main beneficiaries of GM crops due to a 'convenience effect' that includes reductions in farm labor and increased flexibility in the timing of herbicide applications. However, increased weed and pest resistance to these GM crops is already eroding this 'convenience effect'. Additionally, these small convenience benefits do not apply to large-scale growers of cotton in Australia or soybean farmers in Brazil and Paraguay, due to the crises in their respective sectors. Finally, small farmers are neither willing nor able to grow the herbicide-tolerant crops that offer convenience benefits to larger growers.

There are a lack of comprehensive studies on the performance of GM crops in every country that has commercialized them, and this consequently calls into question their claimed benefits. No country in the world has produced a comprehensive study of the real impact of GM crops at the farm level. There is no adequate analysis of pesticide use, yields, weed/pest resistance, or effects upon smaller growers over the short, medium or long term that includes a comparison with existing conventional varieties and other agricultural methods such agroecology or organic food production. Incredibly, industry-funded organizations like ISAAA have been accepted as the official source for evaluations of the performance of GM crops, though they often employ dubious data and flawed methodologies. Furthermore, ISAAA and other industry-funded organizations virtually never confront or even acknowledge problems with GM technology, thus making their conclusions biased.

The world needs sustainable agricultural approaches, and it is high time that governments and agricultural specialists devote their energies to developing techniques and policies that can provide people with healthy food and sustain the world's small farmers.

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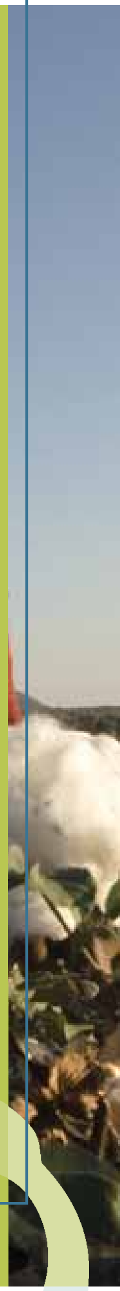

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