Pocket guide
to GM crops and policies

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Agriculture faces serious challenges in the years ahead – but Europe can help the world face these challenges.

1. Introduction

Agriculture faces serious challenges in the years ahead — from a rapidly growing global population that will put increasing strain on the world's food supply, to climate change and its effect on water availability and arable land, to concerns about the environment and biodiversity.

Europe can help the world face these challenges. How? By using less water, increasing our land's productivity to help fight global food insecurity, exploiting less land in other countries for our food needs, and addressing the effects of climate change.

But this can happen only if policymakers give farmers the tools they need to compete and survive in a changing world. The technologies offered by crop science and genetic engineering have a long history of improving agriculture and play a critical role in addressing the challenges of today and tomorrow. GM crops are not the only answer, but their environmental benefits and higher yields make them an option that farmers should have the freedom to choose.

For 15 years GM crops have been increasingly cultivated and consumed all over the world. Concerns about possible negative effects on health and the environment have proven to be unfounded. Around the world, 15.4 million farmers are planting GM crops on 148 million hectares. But Europe has been slow to embrace the technology. This guide aims to provide fact-based information to policymakers, journalists and the wider public, and to show why European farmers should have the freedom of choice that their counterparts in other countries are already exercising.

Time and technology are moving on – is Europe ready to move with them?

“What farmers think”

Name: Gabriela
Profession: 4th Generation Farmer
Country: Portugal
Challenges: Soil erosion, water conservation, sustainable farming

“GM crops are a way to keep farmers on their land in Europe. If we don’t have more GM crops, we will become less competitive and have to import more food as well as use less sustainable farming practices.”

All the hectares on her family’s farm are part of an Environmental Protected Area, under Conservation Agriculture: No-Till and Zone-Till for over 12 years and under Integrated Pest Management.

2. GMOs
The facts

WHAT IS GENETIC MODIFICATION?

Genetic modification means that existing genes are modified or new genes included to give plant varieties desirable characteristics, such as resistance to certain pests or herbicides, or for vitamin fortification.

Because only a few genes with known traits are transferred, GM methods are more targeted and faster than traditional breeding. They are used alongside conventional plant breeding.

WHY DO WE NEED TO 'IMPROVE' PLANTS?

Genetic modification allows scientists to help farmers by adapting plants to certain specific conditions and improving yields. For example, GM maize is better able to resist the European corn borer, a pest that can cause serious damage to maize crops and which increasingly affects European fields and cannot be addressed with conventional means.

GM technology can also help farmers respond to climate change by developing crops that can resist floods or drought.

"There will be no silver bullet, but it is very hard to see how it would be remotely sensible to justify not using new technologies such as GM. Just look at the problems that the world faces: water shortages and salination of existing water supplies, for example. GM crops should be able to deal with that."

Sir John Beddington,
UK Chief Scientific Advisor,
January 2011

GM can also improve consumers' health, for example by producing better cooking oils that don't include trans fats and/or have higher levels of beneficial Omega-3 oils.

GM crops are being developed to help fight malnutrition.

For example, golden rice is bio-fortified with beta-carotene to help combat Vitamin A deficiency, which is responsible for 3,000 deaths per day and 500,000 cases of infant blindness per year in developing countries.

"GMOs or non-GMOs don't excite me all that much - it's a question of innovation. If Europe is going to say 'no' to anything that is new, then we are condemned to backwaters."

John Dalli – Reuters
20 September 2010

? ARE GM CROPS SAFE FOR HEALTH AND THE ENVIRONMENT?

Yes. All GM crops that are currently on the market have proven to be safe. GM products all have to go through a rigorous safety assessment by the European Food Safety Authority (EFSA).

> Learn more in the section "GM Regulation in Europe."

In 2000 and 2010, the European Commission released two reports that cover 25 years of research on potentially harmful effects of GM crops or food on human health or the environment: "A decade of EU-funded GMO research (2001-2010)" and "EC-Sponsored research on safety the genetically modified organisms (1985-2000)."

The conclusion?

"According to the projects' results, there is, as of today, no scientific evidence associating GMOs with higher risks for the environment or for food and feed safety than conventional plants and organisms."

DID YOU KNOW?

The first GM plant was a tobacco plant, reported in 1983, but no GM plants were commercially grown until a tomato was commercialised in the US in 1994.
The tomato was genetically modified to slow down a fruit-ripening enzyme, which resulted in tomatoes with a longer shelf life, the so-called "Flavr Savr" tomatoes.
A similar tomato puree sold successfully in Europe.

Globally, more than **2 trillion meals** containing GM ingredients have been eaten over the last 15 years by hundreds of millions of people without one health incident having been identified.

The French Academies of Medicine, Pharmacy and Sciences have stated: *"No evidence of health problems exists in the countries where GMOs have been widely eaten for several years,"* an opinion endorsed by academies of science and medical councils around the world.

Sources

French Academy of Sciences. (2002, December). Genetically modified plants (Report on science and technology No. 13). Paris, France: Author.

A decade of EU-funded GMO research (2001-2010), DG Research, European Commission.

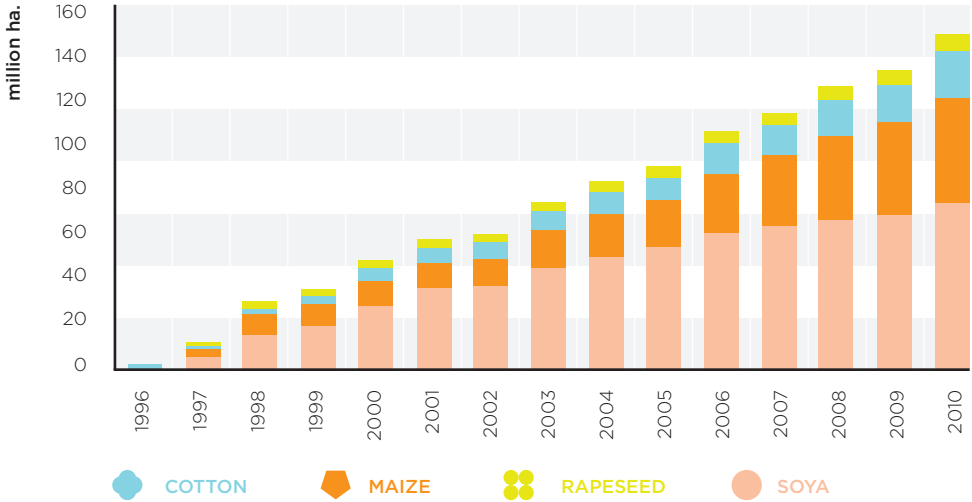
EC-Sponsored research on safety the genetically modified organisms (1985-2000), DG Research, European Commission.

GM worldwide

? HOW MANY FARMERS PLANT GM WORLDWIDE?

A record **15.4 million farmers** grew GM crops in 2010, up from 14 million farmers in 2009. Worldwide, 148 million hectares were planted with GM crops in 29 countries – an 87-fold increase since they were introduced in 1996. This is about the same size as the territories of Spain, Germany and France combined.

GMOs – Global Planting per year since 1996

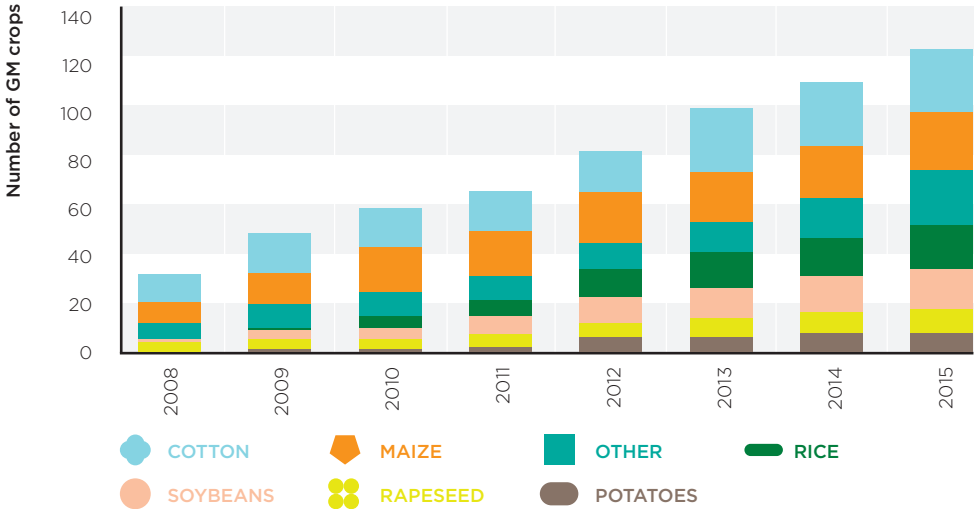


Source

Global Status of Commercialised GM/GM Crops, ISAAA, 2010

Estimate of future numbers of GM crops worldwide

Current numbers and estimations of future numbers of GM crops worldwide



Source

Nature Biotechnology (2010) 28, 23-25 International trade and the global pipeline of new GM crops

? ARE THEY ONLY 'BIG' FARMERS?

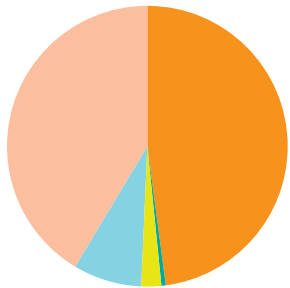
No. Over 90% of the farmers planting GM crops (14.4 million) are small growers in developing countries.

? WHICH GM CROPS ARE GROWN AROUND THE WORLD?

The main GM crops in terms of hectarage are soya, maize, cotton and oilseed rape (canola). Other GM crops that have been approved around the world include sugarbeet, alfalfa, papaya, squash, poplar, tomato, banana, sweet pepper, potato, rice and various ornamental flowers.

Biotech seed market by crop

In 2009, the value of the market for plant biotechnology-based products rose by 15.5% to reach $10,570 million.



Source

Phillips McDougall, 2010

SOYBEAN: 41.4%

COTTON: 7.9%

MAIZE: 47.9%

CANOLA: 2.3%

OTHER: 0.5%

TOTAL = $10.570 MILLION

WHICH IMPROVEMENTS ARE THE MOST COMMON?

Most of the GM crops grown commercially today have improved traits for herbicide tolerance (over 70%), insect-resistance, or both. Other GM traits aim at disease resistance, drought tolerance, health or nutrition benefits, longer shelf life or more efficient industrial use.

WHAT IS NEXT?

There are many more GM crops in the pipeline:

- **Enrichment of grains**, such as 'Golden Rice,' a rice that aims to decrease blindness in children caused by Vitamin A deficiency
- **Healthier vegetable oils,** such as those with fewer trans fats, would also provide benefits to consumers around the world
- **Drought-resistant GM maize** will first be commercially cultivated in the US. Other crops that help farmers cope with challenging agricultural conditions are likely to follow.

WHAT IS THE MARKET SHARE OF GM CROPS?

Market shares vary heavily from crop to crop and country to country. Most of the world's soybean harvest and about half of its cotton harvest are genetically modified today.

Global adoption rates for GM crops

SOYBEAN: 81%
(93% in the US, 99% in Argentina, 75% in Brazil)

COTTON: 64%
(93% in US, 86% in India, 69% in China)

MAIZE: 29%
(86% in US, 56% in Brazil, 86% in Argentina)

OILSEED RAPE: 23%
(88% in US, 94% in Canada)

Source

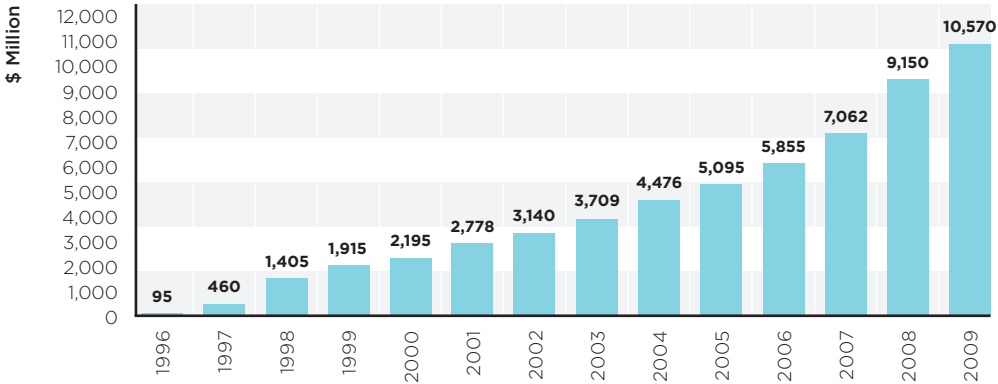
Global Status of Commercialised GM/GM Crops, ISAAA, 2010

“What farmers think”

Name: Maotang
Profession: Cotton farmer
Country: China
Opportunities: Since planting GM cotton, a 10-fold increase in yield (1800-1900 k g per ha.), with income of nearly US $40,000 in 2008.
Challenges: Boll worms had devastated his farm 15 years ago.

“As more and more modern technology products are used by farmers and our income increased quite a lot, in my community, farmers do not lack food and clothes anymore. You cannot find a child who cannot afford their education anymore.”

Growth of the biotech seed market



The largest share of the biotech crops sector is attributed to herbicide tolerant crop varieties, which represented 51.3% of the value of the sector in 2009. However, over the last few years the overall share attributable to stacked trait crop varieties of maize and cotton has increased at a rate ahead of the overall market, to reach a value equivalent to 37.7% of the overall biotech seed market.

Source

Phillips McDougall, 2010

WHICH COUNTRIES ARE THE LEADERS IN GM CROP CULTIVATION?

The **top ten countries planting GM crops** each grew more than 1 million hectares in 2010: USA (66.8 million hectares), Brazil (25.4 million), Argentina (22.9 million), India (9.4 million), Canada (8.8 million), China (3.5 million), Paraguay (2.6 million), Pakistan (2.4 million), South Africa (2.2 million) and Uruguay (1.1 million).

Brazil, for example, has dramatically expanded its planting of GM crops. In the crop season of 2010 to 2011, more than three-quarters of the land used in Brazilian soybean agriculture was planted with GM seeds.

DID YOU KNOW?

Oils from GM plants still need to be labelled in Europe, even though the GM label does not refer to any GM material present in the oil.

? WHY ARE FARMERS PLANTING MORE GM CROPS WORLDWIDE?

- Higher yields
- Higher farm income
- Increased management flexibility
- Easier adoption of no/reduced tillage practices, which save time and equipment usage
- Improved weed control
- Less worry about pest damage
- Less time spent on crop walking and/or insecticide application
- Savings in energy use – mainly associated with less spraying and tillage.
- Savings in machinery use (for spraying and possibly reduced harvesting times)
- Improved quality (e.g., lower levels of mycotoxins in GM insect-resistant maize)
- Soil preservation

Sources

"Plain Facts about GMOs" (2011) Hungarian White Paper

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Graham Brookes and Peter Barfoot. "GM crops: global socio-economic and environmental impacts 1996-2009," April 2011.

3. **GM crops, food and feed** in Europe

Planting statistics for EU countries
In 2010, eight European countries planted GM crops on a total of 91,438 ha.

Spain 	76,575 hectares Bt **MAIZE**
Portugal 	4,868 hectares Bt **MAIZE**
Poland 	3,000 hectares Bt **MAIZE**
Slovakia 	1,248 hectares Bt **MAIZE**
Romania 	822 hectares Bt **MAIZE**
Czech Republic 	4,680 hectares Bt **MAIZE** 150 hectares GM **POTATO**
Sweden 	80 hectares GM **POTATO**
Germany 	15 hectares GM **POTATO**

DID YOU KNOW?
Genetic modification is also used to change the colour of ornamental flowers. The company that put GM carnations on the market has now also developed GM roses with blue flowers, which are available in Japan.

Missed economic benefits for European farmers

A recent study by the University of Reading (UK) has revealed that European farmers are missing out on €443 and €929 million each year because they are not allowed to grow GM crops.

For example, if farmers could adopt insect-resistant **Bt maize** in countries other than Spain, the **estimated value to farmers could range from €157 million to €334 million per year.**

If insect-resistant **GM cotton** was also available for cultivation in the EU, the potential benefit of approximately €80/ha to farmers with about 260,000 ha of cotton in Greece and Spain would result in **€20.8M/year.**

Estimated increase annual income if GM maize was planted across EU

Country	From €M	To €M
Bulgaria	3.6	5.4
Czech Republic	4.6	9.2
Germany	25.7	42.4
Greece	1.2	5.9
France	34.2	85.5
Italy	40.6	108.2
Hungary	6.2	12.6
Austria	12.0	16.8
Poland	11.9	29.9
Portugal	1.4	2.4
Romania	12.1	21.5
Slovakia	3.6	5.9
Total	**€157 million**	**€334 million**

The estimated benefit of growing **HT soybeans** in Europe would be between **€5M and €19M.** Introducing **GM oilseed rape** to Europe would bring a potential annual benefit to EU farmers between **€195 and 318M.**

Another recent study (Brookes and Barfoot, 2011) shows how much GM crops have benefited farmers in the rest of the world. Since 1996, farmers globally have gained more than **€44 billion** in farm income thanks to GM crops, and 57% of this profit was due to increased yields.

? WHICH GMOS CAN BE CULTIVATED IN THE EU?

As of March 2011, just **two GM crops** have been approved for cultivation in Europe. The more widely grown of the two, MON810, is a type of maize that helps fight off pests, such as the European corn borer. The other is a potato for industrial use called Amflora, approved in 2010. Its waxy starch content is useful for making paper, for example. Several member states have issued (legally questionable) bans on cultivation of one or both of these crops approved at EU level.

Source

Julian Park, et al. "The Impact of the EU regulatory constraint of transgenic crops on farm income." New Biotechnology, February 2011.

Graham Brookes and Peter Barfoot. "GM crops: global socio-economic and environmental impacts 1996-2009," April 2011.

? WHICH GMOS CAN BE IMPORTED INTO THE EU?

As of May 2011, a total of 36 GM crops were approved for imports and processing and/or for food and feed in Europe. More than half of those crops were types of GM maize. Other crops included soybeans, rapeseed, sugarbeet and cotton.

? WHY DO WE IMPORT GMOs?

Europe imports a substantial portion of its animal feed, and a large part of the world's supply is GM. Around 30 million tons of grain are imported, per year, from third countries, including 13 million tons of soybeans, 22 million tons of soymeal, 2,5 million tons of maize, 2 million tons of oilseed rape and 0.1 million tons of cotton. European animal farmers rely on soybeans imports for animal feed. Europe imports most of the soybeans it uses, and those imports are mostly GM from North and South America.

? WHAT DO EUROPEANS THINK ABOUT GM?

Anti-GM groups claim that Europeans are overwhelmingly opposed to GM food and crops. But often they base these claims on incorrect readings of public opinion polls. What do surveys actually say about the current state of public opinion?

Sources

DG AGRI Report (2011) Study on the Implications of Asynchronous GMO Approvals for EU Imports of Animal Feed Products.
http://ec.europa.eu/agriculture/analysis/external/asynchronous-gmo-approvals/full-text_en.pdf

Danish Ministry of Food, Agriculture and Fisheries (2009) GMOs - what's in it for us? Report
http://www.fvm.dk/GMO.aspx?ID=42573

"EU experts approve trace GM in feed imports: official." Reuters, 22 February 2011.
http://www.reuters.comarticle/2011/02/22/us-eu-gmo-imports-idUSTRE71L3V420110222

European public opinion
Some polling results and questions are misleading. For example, some polls asked people to rank their levels of concern and asked them to agree or disagree with statements like "GM food is unnatural", "makes you feel uneasy" or "GM food is not good for you." Questions that ask people to quantify "how worried they are" obviously record high levels of concern. Reliable public opinion pollsters don't use such methods; instead, they ask people to rank their concerns instead of prompting them with suggestions of what those concerns might be.

Eurobarometer did this in 2010, asking 16,000 Europeans: *"... in your own words, what are all the things that come to your mind when thinking about possible problems or risks associated with food and eating? Just say out loud whatever comes to mind and I will write it down."*

Only 8% of Europeans spontaneously say they are worried about GM in food. People are more worried about: 1) chemical products, 2) food poisoning, 3) diet-related diseases, 4) obesity, 5) lack of freshness, and 6) food additives, colours and preservatives.

"It is important that we tone down the debate on GMOs to a rational level."

John Dalli,
EC Commissioner for Health and Consumer Policy
on 17 March 2011

Consumer purchasing behavior
Although there is concern about GM and biotechnology, consumers report a low level of knowledge about GM food. When a consumer has no direct experience or verifiable evidence to support concerns, he or she takes a much more cautious approach. In one recent survey, 34% of Europeans found a clear deficit of information on GMOs; as a result, many have yet to form their final opinion on the subject.

The EU Research Project CONSUMERCHOICE looked at the actual purchasing behaviour of consumers when given the opportunity to choose between GM and non-GM foods. The project found that responses given by consumers when prompted by questionnaires about GM-food are not a reliable guide to what they do when shopping in grocery stores. Furthermore, the study concluded that Europeans do buy GM-foods when they are physically present and labelled on the shelves.

Still, even now a large percentage of people recognise that there are benefits. **According to another Eurobarometer, 77% of Europeans said that they agreed that the European Union should encourage its farmers to take advantage of biotechnology in agriculture.**

Sources

GMO Compass
http://www.gmo-compass.org/eng/news/stories/415.an_overview_european_consumer_polls_attitudes_gmos.html

Special Eurobarometer 354, 2010 Food-related risks
http://www.efsa.europa.eu/en/factsheet/docs/reporten.pdf

Eurobarometer 336 (2010) Europeans, Agriculture and the Common Agricultural Policy
http://ec.europa.eu/public_opinion/archives/ebs/ebs_336_en.pdf

Special Eurobarometer Biotechnology, 2010
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ConsumerChoice:
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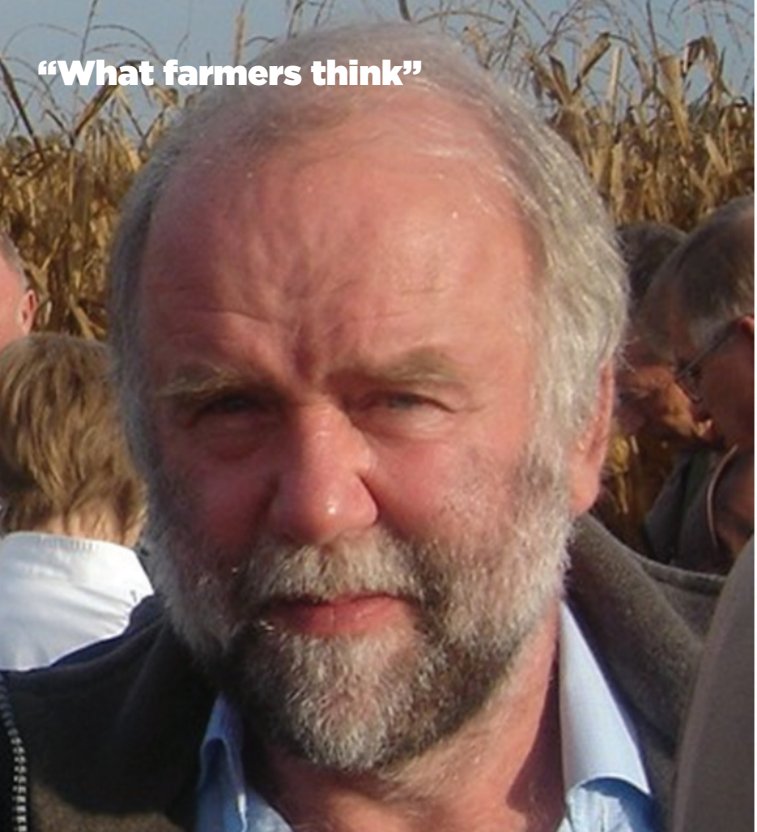


Name: David
Profession: Farms cereals, oilseed rape, and grass for seed
Country: Norfolk, UK
Challenges: Need to produce more while also protecting the environment – but no GM crops appropriate for UK cultivation have been approved
Opportunities: Participated in a GM crop trial and sees the need for GM crops in the UK

“I think there is a big future with GM crops, but if we don’t get a move on, Europe risks denying European farmers access to the biggest environmental advance that we have seen in the last 20-30 years, and at a time when we really need it. I for one would like to grow GM crops again given the opportunity”.

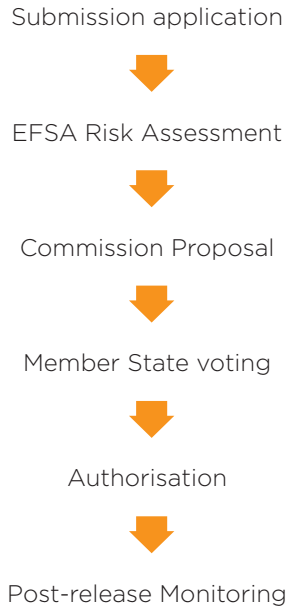
4. **GM Regulation** in Europe

HOW ARE GMOS REGULATED IN EUROPE?

GMOs cannot be put on the market without prior EU approval, whether it for importing a food or feed product made from GM crops or for planting GM seeds. The EU approval system is widely recognised as one of the most stringent in the world.

WHAT IS THE APPROVAL PROCESS FOR GMOs IN THE EUROPEAN UNION?

1. **Risk assessment** is done on a case-by-case and step-by-step basis.
2. When the European Food Safety Authority (EFSA) has completed the environmental, human and animal health safety assessment, its recommendation, if positive, forms the basis of a **Draft Decision** for approval by the European Commission.
3. Post-release **monitoring, traceability and labelling**: monitoring plans need to be approved prior to marketing the product. Traceability is ensured by labelling and administrative records throughout the food chain.
4. **Public information**: throughout the approval process, information is provided to the public.



5. **Subsidiarity**: even in the European single market, responsibility for some issues may be passed back to Member States, such as the co-existence of GM, non-GM and organic crops.
6. **Compliance** with international trade rules: EU legislation is in line with the international trade requirements of WTO (it is clear, transparent and non discriminatory) and with the trans-boundary movement rules of the UN Cartagena Protocol on Biosafety. However, the political nature of the approval process in practice has led to WTO disputes because of trade disruption.

? HOW LONG DO APPLICATIONS TAKE AND WHAT DO THEY COST?

It takes on average almost **4 years** for a GM import approval to be completed in Europe, which is roughly twice as long as in other comparable jurisdictions. Europe tends to have even longer waiting periods for GM cultivation applications, partly due to political differences among the member states. Costs for applicant companies arise mainly from the large number of studies required and vary from €7 million to €15 million per crop.

"People are now beginning to think seriously about … how we feed 9 billion people in 2050. … I think to rule out GM, which is this major new technology, would be very foolish"

Lord Sainsbury,
former UK science minister
on 14 September 2010

IS THERE AN IMPACT ON INNOVATION?

Developing new GM crops requires significant investments of time and resources. Logically, companies must focus their investments mainly in jurisdictions with workable and predictable approval systems. The ban on most GM cultivation in Europe puts European agriculture at a competitive disadvantage compared to agriculture in the Americas, for example, and increases Europe's import dependency. It has been estimated that European farmers could increase their annual revenues by up to nearly €1 billion if they were allowed to cultivate GM crops, such as maize, cotton, soybeans, oilseed rape, and sugar beets.

Source

Julian Park, et al. "The Impact of the EU regulatory constraint of transgenic crops on farm income." New Biotechnology, February 2011.

HOW IS THE SAFETY OF GM PRODUCTS ASSESSED IN THE EU?

All GM plants used for food or food ingredients, feed, fibre and fuel must undergo a rigorous review of their safety as part of the authorisation procedure before they can be put on the market.

In the EU, this task is carried out by the EFSA, whose panel of independent scientific experts cooperates

closely with national authorities on food safety. Only products that have been deemed safe are allowed to reach the market.

The safety of GM crops is deemed on two levels: the way they are produced and their specific new characteristics resulting from genetic modification. The goal is to ensure that the GM product is safe and does not harm humans, animals or the environment.

? HOW IS CHOICE FOR CONSUMERS AND FARMERS GUARANTEED?

Labelling is mandatory within the EU for all food and feed products consisting of, containing, or obtained from GM plants when this is above 0.9% of that ingredient. This allows consumers to make an informed choice. The 0.9% threshold was determined by politics and has no foundation in any scientific finding or fact. It is important to remember that in many cases the introduced trait in the GM plant simply helps improve the field performance of the crop. For farmers, choice is guaranteed through coexistence measures for organic, GM and conventional crops. Across the EU, co-existence measures have been very successful.

Current political situation for GM in Europe

- **Imports with GM material not yet approved in the EU:** To date, the EU operates a zero tolerance policy on imported goods that contain even the tiniest traces of GMOs. In February 2011, Member State experts agreed to allow traces of less than 0.1% of GM material not yet approved in the EU in animal feed.

DID YOU KNOW?
If EU farmers were allowed to grow GM crops, Europe's economy could be boosted by €443 and €929 million each year.

5. **Global challenges**

How can GM crops help?

The global picture: We face increasing demand for the world's finite resources

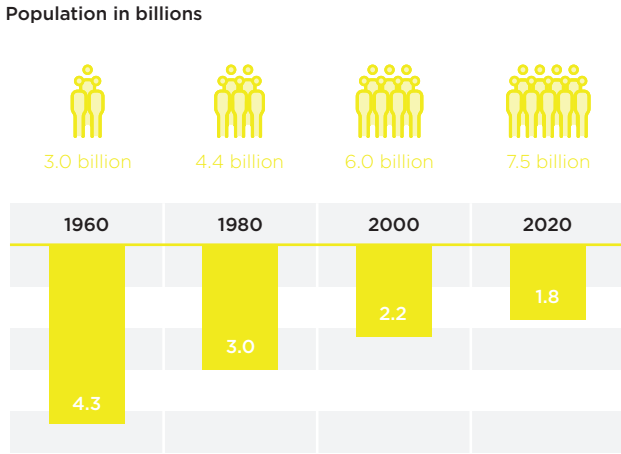
Population growth
From 1960 to 2007, the global population grew from 3 billion to over 6.5 billion. Projections for future growth take that number to nearly 9 billion in 2050. The UN Food and Agriculture Organisation (FAO) estimates that **food production must increase by 70%** if we are to feed the world population.

Population growth, actual and projected 1960 - 2050

Arable land
Around the world, the ratio of arable land to population is steadily declining. Between 1960 and 2000, it declined by about 40%, but in developing nations the decline has been fastest. In Africa, for example, the ratio of arable land to population declined by 55% in the same period.

This means more food will need to be produced on less land to provide enough food without harming the environment.

More food must be produced on less land (FAOSTAT)



“What farmers think”

Name: Karim
Profession: Cotton farmer
Country: Burkina Faso
Challenges: Dry conditions and the need to apply pesticides many times, which means a lot of physical labour
Opportunities: 30% more cotton grown after using GM cotton and a reduction of pesticide applications. Would like to grow GM cereals that resist drought and disease in the future.

“We experienced a parasite problem in 1987-1988. This was the year when people treated their crops with pesticides up to 18 times. And since that year, when you grow cotton, you put it in the ground and you are worried. You couldn’t even sleep when you plant cotton because you don’t know if you can cope with the parasites. But with GMOs, when you plant, now you can sleep.”

Climate change
Climate change is expected to increase the number of people living in poverty by as many as 40 to 170 million worldwide. Water scarcity is also expected to increase, affecting between 75 and 200 million people in Africa alone by 2020. Cereal yields are expected to decline in more than 40 developing countries with average losses of 15%.

Drought and erosion
About 1 billion people, or about 15% of the global population, have been affected by land degradation since 1981.

Over the past 30 years, droughts have dramatically increased in number and intensity in the EU.
The number of areas and people affected by droughts went up by almost 20% between 1976 and 2006.
Globally, between 20,000 -50,000 km^2 of arable land is estimated to be lost annually through degradation, especially soil erosion.

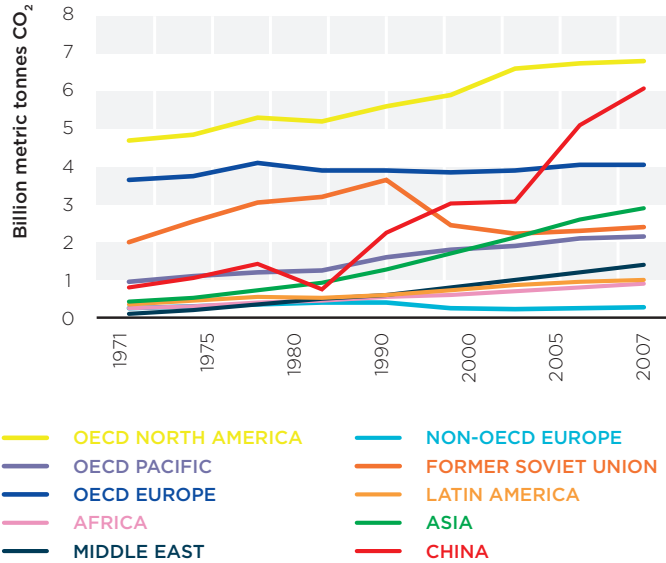
The United Nations Convention to Combat Desertification (UNCCD) estimates that by the year 2050, half of the current arable land will become unusable.

Carbon emissions and air pollution

A rise in carbon emissions has resulted in a current level of 390 parts per million (ppm) of CO_2 globally, much higher than the pre-industrial 18th century level of 280 ppm.

Losses in crop yield caused by air pollutants have been estimated to cause economic losses for 23 arable crops in Europe, totalling €4-8.4 billion/year.

CO_2 emissions from fuel combustion, 1971 - 2007 IEA(2009)



Water use

Water use has tripled over the last five decades. Agriculture accounts for approximately 3,100 billion m^3, or 71% of global water withdrawals today. Without efficiency gains, this will increase to 4,500 billion m^3 by 2030 (a slight decline to 65% of global water withdrawals).

A 1% increase in water productivity in food production can potentially make an extra 24 litres of water available per day per person.

On average, it takes about 3,000 litres of water per person to produce our daily intake of food.

DID YOU KNOW?

In the US, the Keystone Field to Market study found that 50,000 fewer gallons of water are needed to grow an irrigated acre of corn today, compared to 20 years ago.
Today, one irrigated acre of cotton requires about 30% less water than two decades ago.

HOW CAN GM CROPS HELP?

Although they weren't originally developed to cope with the effects of climate change, many GM crops help conserve water, prevent erosion, decrease carbon emissions, and grow more on less land.

GM crops can help:

- Improve yields while using water more sustainably: **Yields can be increased** by 6%-30% on the same amount of land, avoiding the need to plough up land that is currently a haven for biodiversity
- Use low- and no-till farming methods. Fuel use and **CO_2 emissions can be decreased** thanks to less tillage. In 2009, this led to global emissions reductions of 17.7 billion kg of CO_2, equivalent to 7.8 million fewer cars on the road for one year.
- **Protect soils** from erosion through less ploughing, conserving soil moisture, too.
- **Protect crops** from insect damage, significantly reducing the number of applications of pesticides, herbicides and fertilisers.

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Harald von Witzke and Steffen Noleppa.
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Can more efficiency prevent increasing 'land-grabbing' outside of Europe?"
http://www.opera-indicators.eu/assets/files/News/Final_Report_Humboldt_Opera.pdf

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Challenge: Sustaining biodiversity

Due to the increase in land cultivation, population growth and other environmental pressures, the diversity of plant and animal life is at risk. The 2010 biodiversity target to achieve a significant reduction of biodiversity loss, set by world governments in 2002, has not been met at a global level. Across the globe, natural systems that support economies, lives and livelihoods are at risk of rapid degradation, with significant further loss of biodiversity becoming increasingly likely.

? HOW CAN GM CROPS HELP SUSTAIN BIODIVERSITY?

According to a recent peer-reviewed literature review, "Impacts of GM crops on biodiversity", GM crops have a number of effects that help to sustain biodiversity.

"GM can bring benefits in food to the marketplace. There are benefits to developing countries, like drought resistance or resistance to high salt content in water. The principle of GM technology is [OK] if used well. The technology can be beneficial."

Caroline Spelman,
UK Environment Secretary
on 4 June 2010

1. By increasing yields on existing farmland, GM crops help preserve natural habitats and our world's biodiversity. Researchers estimate that 2.64 million hectares of land would probably be brought into grain and oilseed production if GM traits were no longer used.

2. GM crops help facilitate conservation tillage practices, preserving soil and moisture.

3. GM crops have not decreased crop diversity.

4. Plant biotechnology is a powerful tool to help feed a growing world, sustainably.

5. Bt crops can provide area-wide target pest suppression, reducing crop losses and the need for pest control measures.

6. Mounting evidence shows that GM crops have no significant adverse effects on non-target organisms.

Source

Carpenter, Janet (2011)
"Impacts of GM crops on biodiversity."
Nature Biotechnology.

Challenge: Food security

Increase in hunger and malnutrition
FAO's projections revealed that even before the surge in food prices in 2008 and the global economic crisis in 2009, long-term trends of increasing hunger were already apparent. FAO estimates that 1.02 billion people were undernourished worldwide in 2009, representing an increase of 178 million from the nearly 842 million in 1990-92.

In 2009, the FAO estimated world hunger to have reached a historic high with 1.02 billion people going hungry every day.

The recent food price spikes in 2010 and 2011 have further contributed to hunger around the world, and experts, such as economist Jeffrey Sachs, have called on G8 governments to put their words into action by creating a $22 billion fund for smallholder farmers as agreed in 2008.

"GMOs offer potential of increased agricultural productivity, improved nutritional values that can contribute directly to enhancing human health and development"

World Health Organisation, http://www.who.int/foodsafety/biotech/who_study/en/index.html

HOW CAN GM CROPS HELP FOOD SECURITY?

Ensuring plentiful and affordable food around the world requires every tool available, including good policies that are put into action, better incomes for farmers, improved irrigation, stable food prices, among many other factors.

GM crops' benefits, like higher yields on smaller areas of land, lower pesticide costs for farmers, and crops that grow better in local conditions, are just one part of the answer.

Sources

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"Ugandan scientists grow GM banana as disease threatens country's staple food." The Guardian, 9 March 2011. http://www.guardian.co.uk/world/2011/mar/09/gm-banana-crop-disease-uganda

"Special on Feeding the World." The Economist, February 2011. http://www.economist.com/node/18200678

6. **FAQ**
GM controversies

? WHY DO GM CROPS HAVE PATENTS?

Agricultural innovation plays a key role in driving long-term agricultural productivity, rural development and environmental sustainability by encouraging new solutions. For this reason, innovation needs to be supported and protected.

In any industry, the maintenance of Intellectual Property Rights (IPR) is an essential basis for innovation and progress.

- IPR encourages continued investment in research and development, and ensures the plant science industry maintains its strong innovative base.
- Patents form the cornerstone of intellectual property protection
- The protection of regulatory data and confidential business information for biotechnology inventions are important to support innovation and development.

The plant science industry is one of the world's most research-and-development-intensive sectors. It ranks in the top four global industries in terms of percentage of sales invested in R&D. For example, the industry's top

"The Food and Agriculture Organization estimates that developing countries will have to boost their yields by half to meet the challenge of global hunger. We simply won't be able to meet that goal without using all the scientific tools at our disposal."

Bill Gates,
Gates Foundation

10 companies invest $2.25 billion, or 7.5% of sales, in the research and development of cutting-edge products in crop protection, non-agricultural pest control, seeds and plant biotechnology. All of these products aim to improve sustainable agricultural production.

? ARE GM CROPS SAFE FOR HUMAN HEALTH AND THE ENVIRONMENT?

Yes. Two European Commission reports covering 25 years' worth of research on the effects of GM crops on health and the environment have shown no scientific evidence associating GMOs with higher risks than conventional plants and organisms (A decade of EU-funded GMO research, 2001-2010 and EC-Sponsored research on safety the genetically modified organisms, 1985-2000). More than 2 trillion meals containing GM ingredients have been eaten over the last 15 years by hundreds of millions of people without one health incident having been identified.

DID YOU KNOW?

Burkina Faso, a small West-African country, cultivated on its own almost 3 times as many GM crops in 2010 than the whole of the EU together. 80,000 small farmers grew 260,000 hectares of insect-resistant cotton in Burkina Faso in its third year of commercial GM cultivation.

? ARE BIOTECHNOLOGY COMPANIES THE MAIN BENEFICIARIES OF GM TECHNOLOGIES?

Farmers get a direct profit (12%-21% on average) from growing GM crops via higher yields and lower pesticide applications. A recent study (Brookes and Barfoot, 2011) shows how much GM crops have benefited farmers throughout the world. Since 1996, farmers globally have gained more than **€44 billion in farm income** thanks to GM crops, and 57% of this profit was due to increased yields. In Europe, as in the rest of the world, two thirds of the benefits of growing GM are shared among European farmers and consumers, while one third goes to the developers and seed suppliers.

Another recent study by the University of Reading (UK) showed that EU farmers are missing out on €440-930 million each year, simply because they do not have access to the GM crops that could be grown here.

Why do 15.4 million farmers choose to plant these crops on 148 million hectares worldwide? Because they benefit from the technology.

Sources

Demont, M., K. Dillen, and E. Tollens, 2007. "GM crops in Europe: How much value and for whom?" EuroChoices, 6(3):46-53.

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? ARE GM PLANTS FERTILE, OR DO FARMERS HAVE TO BUY NEW SEEDS EVERY YEAR?

All GM plants commercialized so far are as fertile as their conventional counterparts. Nevertheless, GMO opponents have claimed that companies plan to use Genetic Use Restriction Technologies (GURTS) — or so-called 'terminator' technology — to prevent farmers from planting saved seed in the following season. This has now become something of an urban myth that "terminator" seed is being sold.

There are no such crops in the marketplace. Recognising the sensitivity of the subject, the major GM companies have pledged not to use the technology. Note that GURTS and hybrid seeds should not be confused. Already, many farmers, particularly in developed countries, prefer to buy new seed each year because it produces better yields. In the case of some hybrid crops such as maize and many vegetables, buying new seed is preferable, as the harvested crop does not breed true. This has not prevented hybrid seed dominating the market, even in developing countries such as India.

DO GM CROPS HELP REDUCE PESTICIDE APPLICATIONS?

Herbicide-tolerant and insect-resistant plants account for more than 95% of the GM crops at present; both contribute to a reduction in farmer's application of plant protection products.

A recent large project made an inventory of altered agrochemical use per hectare of transgenic crops compared with conventional crops by collecting data from public sources, including scientific literature and reports published by dedicated institutions. Several major studies in the US reported lower herbicide use (up to 25-33%) in herbicide-resistant crops (oilseed rape, cotton, maize, soybean) compared to their conventional counterparts. The results have been published in a comprehensive article by Kleter, et al.

DID YOU KNOW?

In 2010 only 79 GM field trials were carried out in the EU, more than half of which were in Spain.

The number of GM field trials is declining year-by-year and reflects the shift of research to other parts of the world.

Also for insect-resistant Bt crops, many scientific studies show a decrease in insecticide spraying. In France, it was estimated that the 22,000 ha of Bt maize cultivated in 2007 saved up to 8,800 litres of insecticide spraying. In Spain, farmers growing Bt maize applied almost three times less agrochemical treatments per year compared to conventional maize farmers.

? DO GM CROPS REALLY HAVE HIGHER YIELDS?

GM crops allow farmers to protect and preserve yields from damage from pest and weed pressure. A study on the impact of nine years of commercial cultivation of Bt maize in Europe showed that there have been important yield and net economic benefits at the farm level. In all European countries growing Bt maize, yield gains were reported, ranging from 5-15% up to 25% in heavily infested regions.

A study by the Joint Research Centre showed that GM maize increased farm income by up to €122 per hectare, led to higher average yields of 11.8% in an area of heavy insect pressure, and resulted in a reduction in insecticide costs by as much as €20.04 per hectare.

Sources

Kleter GA, Bhula R, Bodnaruk K, Carazo E, Felsot AS, Harris CA, et al, Altered pesticide use on transgenic crops and the associated general impact from an environmental perspective. Pest Management Science 53:1107–1115 (2007a).

Orama report (2007) GM Maize in the field: conclusive results http://www.agpm.com/en/iso_album/technical_results_btmaize_2006.pdf

CAN GM, CONVENTIONAL AND ORGANIC CROPS COEXIST?

Yes. In Europe, for example, over 10 years of experience with Bt maize in Spain has shown that farmers can and do manage coexistence in practice.

A labelling threshold of 0.9% has been set for GM content in conventional and organic crops, as long as growers have demonstrated that they have taken reasonable precautions to prevent inter-mixing. In the vast majority of cases, measured GM content falls well below the 0.9% threshold. If not, labelling is required. As long as this standard can be maintained, coexistence is perfectly possible and presents no problems.

HAVE THERE BEEN MANY CASES OF GMO CROSS-FERTILISING WITH NON-GM PLANTS? ARE FARMERS' LAND OR LIVELIHOODS BEING AFFECTED BY CROSS-FERTILISATION?

There may be individual cases of cross-fertilisation, but these are the exception. In Europe, for example, Spanish farmers have grown GM maize next to non-GM maize for over a decade, and there have been no co-existence-

"We need sophisticated scientific technology to boost our production."

Norman Borlaug,
father of the
Green Revolution

Source

"Can we coexist?"
Tomorrow's Table blog by Professor Pamela Ronald, University of California Davis.
http://scienceblogs.com/tomorrowstable/2011/03/can_we_coexist.php

related problems through voluntary schemes. Spanish farmers employ practical measures based on extensive cooperation. These include: isolation distance and rows, planting near other crops, different flowering dates, cleaning of equipment, traceability and labelling, testing, etc.

? ARE INSECT RESISTANT CROPS TOXIC TO 'NON-TARGET' ORGANISMS, LIKE BUTTERFLIES?

There is mounting evidence that shows that GM crops have no significant adverse effects on non-target organisms. Many studies have confirmed that Bt is more specific and has fewer side effects than conventional pesticides. In fact, Bt has been used in organic farming as an alternative to conventional insecticides for almost 60 years. It is regarded as highly selective and environmentally friendly.

Two meta-analysis studies in the renowned scientific magazines Science and Nature Genetics looked at the effects of Bt. They concluded that:

- Non-target organisms are generally more abundant in Bt maize fields than in non-transgenic fields managed with insecticides.
- Bt crops grown today are more specific and have fewer side effects on non-target organisms than most insecticides currently used. Bt technology can contribute to natural enemy conservation and can be a useful tool in integrated pest management systems.

Bt has a long history of safe use for more than 40 years, including by organic growers:

It has long been known that a common soil bacterium called Bacillus thuringiensis (often referred to as Bt) produces proteins that kill specific insect larvae, though it is harmless to other animals and humans.

In fact, numerous spray formulations containing the commonly occurring Bt soil bacterium have been used for more than 40 years for crop protection, including organic farming operations. However, an additional environmental benefit of Bt maize, as compared to maize sprayed with organic and synthetic insecticides, is that the Bt maize plants provide insect protection much more selectively, without the need for spraying.

Source

Carpenter, Janet E. "Impacts of GM crops on biodiversity." GM Crops 2:1, 1-17; January/February/March 2011.

7. **Principles**

Principles

GMOs have been tightly regulated since their inception, and the EU system for GM approvals is one of the strictest in the world. Cultivation and imports are only possible with previous approval at EU level. Against this background, the biotech industry supports:

FREEDOM OF CHOICE

Both farmers and consumers should be free to decide whether they want to cultivate or consume GM products or not. Europe has created a labelling framework to address consumers' choice as well as guidance on co-existence of different farming models (conventional, organic and GM). EU farmers, however, are being given very little choice, because they are only allowed to grow two GM crops. In the Americas, farmers can choose between more than 25 GM crops to grow.

FACT BASED DECISION-MAKING

An objective, scientific evaluation of the safety of GM products is rightfully the basis for approvals in the EU and in other parts of the world. Safe products should be allowed onto the market. Science-based decisions should not be misused for political purposes.

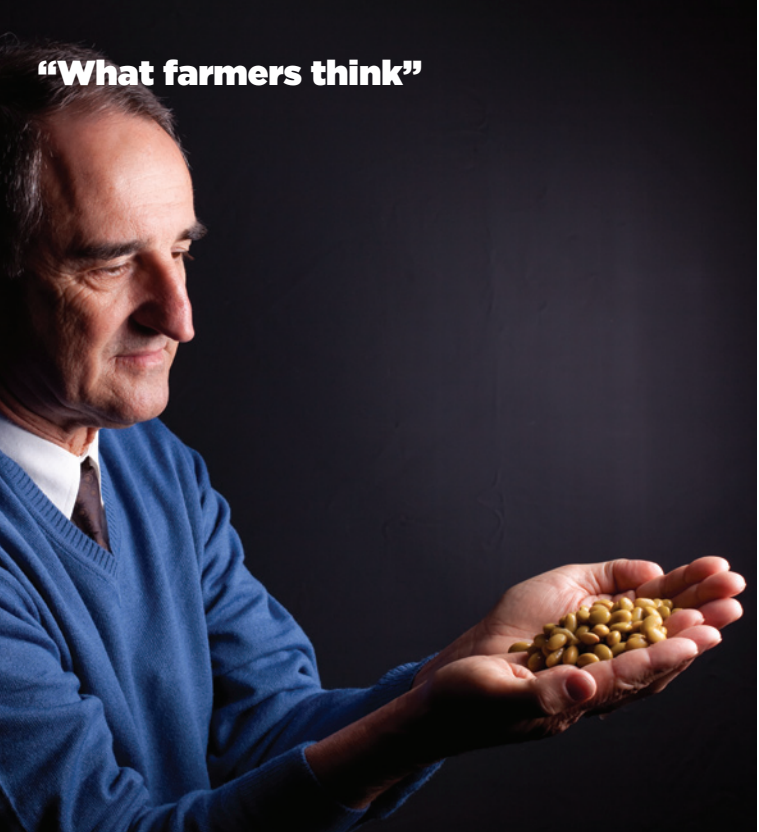
Principles

WORKABLE APPROVALS SYSTEM

There is a clear potential for to make the EU approval system more efficient.
Even the strictest approvals system should offer applicants a minimum level of predictability. Currently, applicant companies comply with all requirements but have no certainty about how many years it will take until a decision is made. Requirements are frequently changed mid-procedure. Even once their product is proven safe, there is still no certainty if or when it will be approved. There is a clear potential for speeding up the process whilst maintaining the same strict standards.

PUBLIC ENGAGEMENT AND POLITICAL RESPONSIBILITY

The biotech industry plays an important role in increasing public understanding of the technology. Industry has always been and continues to be committed to communicating about all aspects of GM food and crops.
Others must also play a role in responsible public communication, including politicians and officials at national and international level, food manufacturers, traders and sellers, farmers, scientists and consumer, development and environmental groups.



Name: Carlos
Profession: Farmer
Country: Brazil
Challenges: Need for higher soy production on existing land & remaining competitive

“Biotechnology has delivered increased productivity, reduced costs and better soil management. GM seeds make soil management easier, they work well with the direct seeding technique and help to better control pests compared to conventional varieties.”

8. Index

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