The EU's Biotechnology Strategy: mid-term review or mid-life crisis?

A scoping study on how European agricultural biotechnology will fail the Lisbon objectives and on the socio-economic benefits of ecologically compatible farming

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Friends of the Earth Europe

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Friends of the Earth Europe

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Executive Summary

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"By keeping Europe at the cutting edge of biotechnology research, we will also contribute to the more general goals of creating more highly-qualified and well-paid jobs, boost economic growth and improve our terms-of-trade."

Gunter Verheugen, European Commission Vice President, Press release, 2005

"Statistics on biotechnology employment cannot be obtained from official sources [...] because standardised data collection is not available for this industry that stretches across several industrial sectors. Some data is available, but mainly categorised in employment per Member State, not per biotechnology sector (white, green and red), which is a less than precise definition."

Gunter Verheugen, European Commission Vice President, written response to parliamentary question, 2006

In 2000, the EU announced that it was to become "*"the most competitive and dynamic knowledge-based region in the world" based on the realization that "economic growth, social cohesion and environmental protection must go hand in hand."*[a] These objectives formed the basis of the Lisbon Agenda that all European Heads of State and Governments signed up to. Biotechnology was identified as an important new technology that could contribute to achieving the Lisbon Agenda goals. At the end of the 90s, the European Commission and other agribiotech proponents believed that the greatest economic and employment impacts of biotechnology were likely to occur in the agro-food production chain, and that investments in the sector would lead to millions of jobs being created in Europe. A Biotech Strategy for the European Union was adopted in 2002, setting objectives for the development of all biotechnology sectors, including 'green' or agricultural/food biotechnology. This Strategy is being reviewed in 2007 and new targets will be set for the development of biotechnology in Europe.

Field of wheat.

This report, based on industry and government figures, finds that agricultural biotechnology, including the development of GM crops and foods, has failed to live up to expectations and has failed to deliver on the Lisbon Agenda:

- **It looks at how policies on biotechnology have been created by a European political climate under pressure to ensure job creation and competitiveness and how this is masking the reality of poor agri biotechnology performance.**
- **It exposes the discrepancy between the European Commission's promises on how agricultural biotechnology will achieve economic growth and the lack of data to back up these claims.**
- **It analyses how political and economic decisions that approach biotechnology as one homogeneous sector rather than clearly segmenting it into its different types, is resulting in confused and economically unjustified policies supporting the development of GM crops and foods.**
- **It assesses EU research funding priorities and shows how the political push for agricultural biotechnology is side-lining agri-environmental farming sectors that are already delivering and that show further economic potential. Twenty five years of EU public research have resulted in just 2 types of GM crops being commercialized (herbicide resistance and insecticide tolerance).**
- **It finds that even in the US, which has a different regulatory framework and public awareness than in the EU, the agribiotech sector's performance is poor. Consolidation is hindering market competition and only two traits are being grown to any extent despite US Department of Agriculture approval for 70 distinct biotech 'events' for commercial use.**
- **It addresses the technical and financial risks involved in GM farming due to GMO contamination. Recently, US long grain rice contaminated with GMOs has been found in 17 EU countries, and has resulted in rice prices at nearly 65% below the level forecast by the trend of prices prior to the contamination incident.[b] US rice farmers are now suing the producer, biotech corporation Bayer.**

The report concludes that whilst there may been great expectations of agricultural biotechnology, there have been even greater disappointments. A comparison of the economic performance of food biotechnology with research results from studies into agri-environmental measures indicate that the EU is promoting the application of a technology that is not contributing to competitiveness whilst sectors that show potential are not only not being prioritized, but are put in jeopardy by the risk of genetic contamination by GMOs.

a European Council of Ministers. Presidency Conclusions, Stockholm European Council, 23 And 24 March 2001. http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/00100-r1.%20ann-r1.en1.html

b "Rice Industry in Crisis", Greenpeace, January 2007

	Food Biotechnology	Agri-environment measures and organic farming
Industry competitiveness	> Agribiotech business revenues in the EU are on the decline, public offerings are irrelevant, venture capital investment is minimal, and companies are relocating abroad or shifting to more profitable areas, such as therapeutics. > Both in the EU and in the US, agribiotech companies received less than 1% of the venture capital with the lion's share going to human healthcare and diagnostics.	> Agri-environmental measures show increased profitability for farmers compared to conventional farming > Demand for organic products is growing at double digit rates in many EU countries and outstripping supply > Amount of organic farmland in Africa, Asia and Latin America showing triple digit growth since 2000 > Major food companies have launched or acquired organic brands
Market diversity and innovation	> Acquisitions and mergers have led to just six corporations (Monsanto, DuPont, Bayer CropScience, Syngeta BASF and Dow) dominating GM crop and seed production. This is squeezing out competitors, neglecting smaller markets and decreasing knowledge production.	> Rapid increase in organic holdings in the EU is being accompanied by similar growth in organic processors and importers > Organic farms, especially those where processing and retailing is managed on the farm, are showing quantifiable increased social cohesion of rural communities and stimulation of local economies.
Impact of products	> Only two GM traits have been used on any significant commercial scale. This includes the US where 70 distinct GMO 'events' have been authorized for commercial growing. > Problems are emerging such as increased tolerance to the GM-crops' herbicides, requiring increased levels of chemical applications. > There have been considerable costs to both the GM and the non-GM food chain associated with GM contamination. The European Commission considers GMO contamination a serious problem. In the US, GM rice contamination has caused the rice market to plummet and US farmers suing the biotech producer, Bayer, for loss of market.	> Research shows that organic production - has comparable yields to conventional farming -uses 30% less energy -uses less water -uses virtually no pesticides
Job creation	> There are only 96 500 jobs in biotechnology in Europe of which 80% are in the health sector. > Lack of a profitable market has caused the industry to reorganise its workforce. Cuts have been made in order to meet overall profit targets. The result has been a loss of thousands of jobs in Europe over just a few years.	> Figures from the European Commission and university research indicate that agri-environmental initiatives, including organic farming show job creation including amongst young people. > The organic market is growing: the EU public and more affluent markets in general are showing increased demand for organic produce which is outstripping supply.
GM crops: 25 years of EU research, only two traits	A conservative figure for spending on GMO food research is 400 million euro for the period 1982-2007 with an average of 80 million euro per year (excluding applications like biofuels and pharma crops). This does not take funding by individual member states into account which was for example 47 million euro and 61 million euro for the UK and Germany in 2001 alone. > There is no evidence of revolutionary developments in the foreseeable future – technical and market constraints restrict progress. The European Commission however funds a Technology Platform on plant biotech which is calling for 45 billion euro for agricultural biotechnology by 2015 *"if Europe is to remain competitive."*	Initially funded only through private research institutes, public funding for agri-environmental initiatives has increased in recent years although it remains marginalized. The European Environment Agency recently called for more funding into such initiatives. However, the European Commission's DG research has refused to fund a Technology Platform on organics, and the recently adopted EU Framework Programme 7, worth 50 billion euro, has selected biotechnology in food and agriculture as as a key thematic area.

Executive Summary/Glossary

Recommendations:

1. Mid Term Review of the EU Biotech Strategy should include failure of GM food and crops

- The revised EU Biotech Strategy should ***segment the different biotechnology sectors (green, white, red)*** and assess each one according to its strengths and weaknesses. This should also be done in other policy and legislative processes.
- Member States and the Commission should work together to ensure biotechnology ***sector-specific data***
- The Mid Term Review should take ***current market reality*** into account when deciding actions for food biotechnology. The views of EU citizens, policies of major retailers, and the right to GMfree food and farming must be unconditionally respected. On public opinion, the revised strategy must acknowledge that EU citizens have now been consistently opposed to genetically modified food and crops for ten years.
- Based on the evidence from research, including government and industry figures, the revised EU biotech strategy ***must acknowledge the failure of genetically modified food and crops and therefore exclude this sector when fixing new targets***
- The European Commission should carry out a ***policy-specific audit*** of EU agri biotechnology policies and research funding

2. EU research priorities and funding should focus on agri-environmental sectors

- The EU's framework programme 7 (FP7) should ***de-prioritise its theme on biotechnology and food.***
- ***Future research priorities,*** including under FP7, on competitive agriculture and food sectors should increase focus on the potential, and challenges, shown by **agri-environmental sectors,** including organic farming.
- ***Greater priority should be given to DG Research "Science in society" initiatives***
- ***A Technology Platform*** on organic farming should be funded by the European Commission
- EU funding under FP7 should be made available to develop an ***EU research project on the socio-economic impacts of agri-environmental farming in EU member states.*** Such a study should include stakeholder participation from the very beginning of the study and should be carried out by an independent body, such as the European Environment Agency.

3. Increased political support for agri-environmental measures, and indicators in all policies to ensure all Lisbon agenda goals are met

- ***Binding commitments and increased funding*** for the Common Agricultural Policy (CAP) Pillar 2 must be adopted and implemented by all Member States, when the CAP is reformed in 2008, as agreed in 2003, and as proposed by the European Commission for the Financial Perspectives 2007-2013.
- ***Quantifiable commitments*** to achieving the socio economic and environmental goals of the Lisbon Agenda must be made in EU Industry Policy
- Members of all Commission ***Advisory Groups*** covering food and agriculture must be made public

BBSRC	Biotechnology and Biological Sciences Research Council
BRC	British Retail Consortioum
CAP	Common Agricultural Policy
CBAG	Competitiveness in Biotechnology Advisory Group
DG Research	The European Commission's Research directorate
EU	European Union
GFP	Good Farming Practice
GM	Genetically Modified
GMO	Genetically Modified Organism
JRC	Joint Research Centre of the European Commission's Research Directorate
IFS	Integrated Farming System
ISAAA	The International Service for the Acquisition of Agri-Biotech Applications
M&A	Merges and Aquisitions
R&D	Research and Development
RDR	Rural Development Regulation
UAA	Utilised Agricultural Area
UK	United Kingdom
UUA	Utilised Agricultural Area of the European Union
US	United States

Introduction

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Back in 2000, European Heads of States and Governments made a number of groundbreaking commitments on behalf of the European Union. Member States met in Lisbon to set themselves *the ambitious target of turning the EU, by 2010, into "the most competitive and dynamic knowledge-based region in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion."*[1] The importance of ensuring the synergy between these different policy areas was reiterated a few months later in Stockholm, when Member States agreed that, *"economic growth, social cohesion and environmental protection must go hand in hand."*[2]

In 2001, and always within the context of the goals set in Lisbon, Member States invited the European Commission *"to examine measures required to utilize the full potential of biotechnology and strengthen the European biotechnology sector's competitiveness in order to match leading competitors while ensuring that those developments occur in a manner which is healthy and safe for consumers and the environment, and consistent with common fundamental values and ethical principles."*[3]

Following this request, the European Commission proposed in January 2002, under the title "Life science and biotechnology – a strategy for Europe",[4] a strategic vision and an action plan that aimed at contributing to Europe's competitiveness policy through the potential offered by life sciences and biotechnology in healthcare, agriculture, food production and environmental protection.[5]

Riverford Organic Farm in Devon, UK.

© Ian Jackson/Friends of the Earth

The 8-year long strategy is now in the process of undergoing a thorough mid-term review as a way of reflecting on the role of Life Science and Biotechnology in the context of the Lisbon Agenda. The review will be based on the results of *"a cost-benefit analysis of biotechnology and genetic engineering, including genetically modified organisms, in the light of major European policy goals formulated in the Lisbon strategy, Agenda 21 and sustainable development."*[6]

The European Commission's Joint Research Centre (JRC) in Seville has carried out the cost-benefit analysis following a request by the European Parliament to look at biotechnology in terms of its economic, social and environmental implications. As such, *"[t]he study will constitute the primary input to the reflection on the role of the Life Sciences and Biotechnology in the renewed Lisbon Agenda."*[7]

Independently from the outcome of the study, the European Commission has already made repetitive claims about the importance of investing in biotechnology, for it believes that *"it is evident that modern biotechnology offers unique opportunities to address many needs and could consequently serve as a major contributor in achieving EU policy goals on economic growth and job creation, public health, environmental protection and sustainable development."*[8]

Friends of the Earth Europe believes that these statements are unfounded. For these reasons, this study prefixes itself the task of carrying out an assessment of the socio-economic implication of food and plant biotechnology – from here on referred to as "agricultural biotechnology" – and determine the contribution of agricultural biotechnology to economic growth, job creation and social cohesion in the agricultural sector. The study will purposely avoid discussing the environmental impacts of agricultural biotechnology for these have been discussed at length elsewhere. The study will assess the contribution, if any, of food biotechnology on the goals set by EU Member States in Lisbon in 2000, with particular relevance on those of industrial competitiveness and job creation, whilst also looking at its coherence with the EU's wider commitments, such as sustainable development.

Agricultural biotechnology and the Lisbon Agenda – coherent or contrasting strategies for Europe?

1

This chapter will look at the EU's biotechnology strategy in relation to the objectives set in the Lisbon strategy. The key elements of the Lisbon agenda are identified and set the scene against which an analysis of the European agricultural biotech industry's performance are juxtaposed and assessed. The analysis suggests that the European Commission has developed a blind faith in biotechnology, for support in its application to the agricultural sector appears to be unquestioned, despite data provided by the European Commission and the biotech industry itself pointing towards a failure of the agri-biotech industry to develop innovative products, attract investment and create new jobs in Europe.

1.1. Blind-faith in biotechnology as a strategy for Europe's industrial competitiveness

> *"If Europe wants to avoid playing a passive role, then it is vital that biotechnology is shaped to support European interests in knowledge-based competitiveness [...]"*[9]
>
> **European Commission, 2005**

In March 2000, European Heads of States and Governments met in Lisbon to discuss and agree on a strategy for Europe that would allow the Union to become, by 2010, *"the most competitive and dynamic knowledge-based region in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion."*[10] This ambitious goal was set at a time when the bubble on international financial markets, which had fuelled Europe's boom throughout the 1990s, had not yet burst, but pressure from global markets was beginning to intensify and *"a radical transformation of the European economy"* was seen as necessary to prevent the EU falling behind its competitors, namely the US and China.[11] The European industry was to remain competitive vis-à-vis the external world, capable of competing against foreign companies operating in the EU as well as in other markets worldwide. As a result, the competitiveness of European industry has become, since Lisbon, the EU´s overall policy objective.

In response to this objective, in 2002, the European Commission devised, with reference to biotechnology, an 8 year-long strategy for Europe. At the time, the European Commission stated that *"[a] revolution [was] taking place in the knowledge base of life sciences and biotechnology"* and believed that biotechnology could *"provide a major contribution to achieving the European Community' Lisbon Summit objective of becoming a leading knowledge-based economy."*[12]

However, as the growth rates of the late 1990's, alongside the bubble on financial markets, vanished into thin air, EU Heads of State met in 2004 to carry out a mid-term review of the overall Lisbon strategy. The assessment revealed that the far-reaching goals set just four years earlier were far from being reached.[13] This realization did not lead, however, to challenge the strategy itself, but rather lead the new Commission, and its President Barroso, to downsize the "overloaded" agenda[14] and focus on just two of the original objectives: economic growth & job creation, whilst dropping the goals of social cohesion and environmental protection.[15]

Within this renewed policy framework, European policy was therefore to ensure the fostering of its industry's competitiveness in all policy areas, to the point that, as from 2004, all European regulation (environmental, social, etc) has been assessed against its implications on industrial competitiveness.

On 22nd September 2005, Günter Verheugen, European Commissioner for Enterprise and Industry, and European Commission Vice President presented *"The Commission's new Biotech Policy"* at an event organised by the industry lobby group EuropaBio, the association representing the European biotechnology industry in Europe. In his speech, Verheugen emphasised his support for biotechnology and stated the need for the EU to become competitive and promote biotechnology as a key component of the Commission's new *"Partnership for Growth and Jobs"*.[16] The Commissioner went as far as stating that the new biotech strategy was his *"most important goal as Commissioner for Enterprise and Industry."*[17]

As the next section illustrates, the European Commission is hoping to capitalise and sustain Europe's economy and the competitiveness of its industry through Europe's scientific institutions and its capacity to produce knowledge.[18]

1.1.1. Agricultural biotechnology and EU public research funding

The role of European funding in this approach has been to support basic research that will provide the underpinning knowledge for industry to use (applied research) – see Box 1. The rationale for this approach has assumed a linear relationship between investments in basic science, its subsequent adoption by industry and eventual translation into profit generating products.[19] Without venturing in the economics of innovation, it is sufficient to point out that, although this assumption is not wrong per se, it is incomplete, for it fails to acknowledge two other possibilities: (a) that basic research might not yield any results whatsoever, and/or (b), that the yielded results will not be the ones hoped for.[20] Indeed, as twenty-five years of biotech investment have shown, the assumption of the linearity between investment and output has proven rather optimistic, and most disappointing. As the Biotechnology and Biological Sciences Research Council (BBSRC), the UK's largest funder of plant science, admits, *"there is little or no evidence to date that the high level of investment in plant science is having a significant impact on strategic and applied research in crop science."*[21]

However, as Box 1 illustrates, the European Union, and the European Commission in particular, have been very supportive of agricultural biotechnology over the years. According to the European Commission, the EU-15 annual public expenditure on agricultural biotechnology averages €80 million[22], although the UK and Germany alone spent €47 million and €61 million respectively in 2001, which suggests that the actual EU aggregate figure is much higher.[23]

Genetically engineered corn growing in the USA.

Agricultural biotechnology and the Lisbon Agenda – coherent or contrasting strategies for Europe?

This political and financial support has often led the European Commission to make extraordinary claims over the potential contribution of biotechnology, including agricultural biotechnology, to Europe's wider policy goals.

As the remainder of the chapter will illustrate, by assessing the socio-economic implications of agricultural biotechnology vis-à-vis the Lisbon Agenda, these claims are unfounded.

box 1: The EU's public funding support for the biotech industry

A number of programmes and initiatives have been set-up over the years to provide funding support to the biotech industry in Europe:

- The earliest support for biotech research in the EU dates back to 1981 with the Biomolecular Engineering Programme (BEP), a 4-year programme promoting the training and project exchange between academic research and industry;
- In 1983 biotechnology was declared a priority as a research area and a working party was set-up that year to develop a joint EC R&D programme;[24]
- In 1984 a series of successive ***Framework Programmes for Research and Technological Development*** (FPs) were launched. Programmes whose main thrust was biotechnology, were the Biotechnology Action Programme (BAP) 1986-1989, Biotechnology Research for Innovation, Development and Growth in Europe (BRIDGE 1990-93, and BIOTECH 1992-98), whose focus was primarily basic research;
- However, in 1999, the European Commission unified its funding for biotechnology research under the ***Quality of Life and Management of Living Resources programme,*** that fell under the 5th Framework Programme.[25]

These framework programmes are managed by the Research Directorate of the European commission (DG Research) – see Table 1. Given that research areas were seldom clear-cut in their application, these often overlapped and it proves difficult to define, with precision, the exact amount of expenditure for agricultural biotechnology, for plant genomics is destined, only in part, to food production, whilst a large proportion is destined to other applications such as pharma crops and biofuels. (These crops are not the focus of this report, however it should be noted that these applications of biotechnology raise important food issues: pharma crops can lead, and indeed have in the US, to contamination of food crops whilst biofuel production raises key problems of land use and food security both in the EU and in developing countries)

Hence, bearing the above in mind, and drawing on the European Commission's own data, between 1982 and 2007, ***the European Commission appears to have funded a conservative figure of over €400 million on agricultural biotechnology*** through its various framework programmes. It is important to note, however, that this is a conservative figure for it includes, for instance, just ***€70 million spent between 1985 and 2000*** (for which data is available) ***on 81 projects in the field of GMO safety,*** but the total amount might have doubled by now. Moreover, this figure considers exclusively the funding made available by the European Commission and does not take into account the public funding support disbursed by Member States – see previous section.[26] It is also unclear, moreover, how much of these public funds have been disbursed to the agri-biotech industry itself. Analysis by the European Science Social Forum Network found that ***30% funds under FP6 alone were used to subsidise directly the biotech industry,*** with half of it going to large biotech companies.[27]

table 1: EU Research funding for agricultural biotechnology

Programme	Period	Funds (Millions/Euros)
BEP	1982-1986	€ 6
BAP	1985-1989	€ 9
ECLAIR	1988-1993	€ 30
BRIDGE	1990-1993	€ 16
BIOTECH 1	1992-1994	€ 16
BIOTECH 2	1994-1998	€ 41
FAIR	1994-1998	€ 27
FP5	1998-2002	€ 108
FP6	2002-2007	€ 100
Total	**1982-2007**	**€ 353**

source Personal communication with Bernhard Zechendorf, DG Research. Based on individual project funding under each research programme.

Funding support to the agricultural biotechnology industry has also been made through the ***Competitiveness and Innovation Program*** (CIP), proposed by the Commission, aiming at bringing together, into a common framework, specific support programs in fields critical to boosting European productivity, innovation capacity and sustainable growth. One of the main sub-programs is the ***"Entrepreneurship & Innovation Program"***, including "Financial Instruments" aimed at encouraging and promoting indirectly the access to finance for the start-up and development of small & medium enterprises (SMEs) by means of public investments in venture capital funds such as the ***High Growth and Innovation Facility*** (GIF) set up by the ***European Investment Bank*** (EIB).

Financial support to the biotechnology industry is also steered by a number of advisory bodies made up by the industry itself, which questions the validity of the advice on which the European Commission bases its decisions – see Table 3 for more detailed analysis of these bodies.

1.1.2. Agricultural biotechnology: great expectations, but greater disappointments

"Biotechnology is driving innovation in medicines, agriculture and industry. Biotech-based industrial techniques consume fewer resources, clean up the environment and provide substitutes for more harmful chemical processes."[28]

European Commission, 2005

The first genetically modified (GM) crops made their first appearance on the world's markets back in 1995. These were referred to as "first generation" of GM crops, that is crops carrying agronomic traits, such as resistance to specific herbicides or insecticide, principally in soybeans, cotton, oilseed rape and maize. These traits were meant to provide benefits to the producer of simplified weed and pest management.[29]

"Second generation" GM crops were in the laboratories then, as they still are now, and are being designed to offer benefits to the consumer, in terms of improved quality and nutritional traits, including higher levels of essential amino acids or vitamins, removal of allergens and anti-nutrients, improved starch content and composition, improved fatty acid content, etc. There is also the development of "pharma crops", transgenic plants producing pharmaceutical products including vaccines, therapeutic proteins and other materials with medical benefits, but also coloured cotton, biodegradable plastic, improved soybean and oilseed rape, and improved energy maize.[30]

In 1998 Monsanto claimed that a second generation of GM products would be available by 2002, and similarly, the UK Food Standard Agency had predicted, based on the industry's own estimates, that by 2004-5 a number of second generation products would be commercially available, such as: Golden Rice – a rice supposed to produce beta-carotene, a precursor of vitamin A to be used in vitamin A deficient diet; potatoes with extra proteins; salt-tolerant tomatoes; sunflowers resistant to white mould.[31] The Food Standard Agency (FSA) goes as far as predicting that, by the end of the decade, we will be growing decaffeinated coffee and tea plants, disease-resistant grapes, and plant-based vaccines (food crops genetically engineered to produce edible vaccines).[32]

To date, however, expectations have not been met, since the traits researchers want to enhance involve several genes and complex interactions between the plant and its environment. Moreover, there is still little evidence to support the role of functional foods, whether genetically modified or not, in reducing diet-related diseases and improved public health.[33] The effectiveness and usefulness of Golden Rice is still much debated and not yet commercially available, and the same goes for the few GM blight-resistant potatoes recently approved for testing. No salt-tolerant tomatoes or moult-resistant sunflowers have been marketed yet.

As remarked by MERIT, the Economic and Social Research Centre on Innovation and Technology of the University of Maastricht, GM crops may never offer the most cost-effective solution. The associated costs with contamination of non-GM crops appear to be too high and risky – see Box 4 for examples of recent cases. Moreover "functional foods", such as broccoli with high levels of calcium, or other properties, don't appear to offer much of an advantage, since food processors can either purchase calcium-enhanced GM broccoli or add calcium, derived from other sources, directly to their products. Low or negligible switching costs from one input to another will cause GM products to be uncompetitive.[34]

Hence, despite the industry's promises and the national authorities' euphoria, including the European Commission's, to date the only GM agricultural products that have made it into the market are still only "first generation" GM crops, with 73% of worldwide grown GM crops containing herbicide-tolerant traits, 18% pest-resistant traits, 8% containing both traits, and just 0.1% yield-improvement traits.[35] The vast majority of crops provide cheaper animal feed (soya and maize) for dairy, poultry and livestock producers and are not used for food. However, as the rest of this section illustrates, the performance of just these few traits-enhanced crops has been very poor and, in certain cases, even negative, despite the industry's inflated claims – see Box 2:

Herbicide tolerant GM crops Benefits claimed in relation to herbicide tolerant crops include reductions of herbicide use or the replacement of more toxic herbicides.[36] However, the emergence herbicide resistance in weeds has threatened the long-term weed control effectiveness of the technology.[37] This has been the case of Monsanto's Roundup ready soybeans, the most extensively grown GM crop today, which was found to lead to an increase use of herbicide use. The planting of 550 million acres of GM maize, soya and cotton in the US since 1996 has increased the amount of pesticide used by about 22.5 million kg, according to a study published in 2003 by the Northwest Science and Environmental Policy Centre.[38] No increased yields have been recorded for GM herbicide tolerant soybeans, maize and cotton, even by analysts who are highly in favour of the technology.[39] Reasons for this are that farmers have had to spray incrementally more herbicides on GM crops in order to keep up with shifts in weeds towards tougher-to-control species, coupled with the emergence of genetic resistance in certain weed populations.[40]

Agricultural biotechnology and the Lisbon Agenda – coherent or contrasting strategies for Europe?

Insecticide resistant GM crops The industry has claimed some economic benefits to a small number of Spanish farmers through reduced insecticide use against the corn borer pest afflicting their cornfields.[41] However, these impacts have been noted only in areas where corn borer pest infestation levels were high. At low and medium infestation levels, there was no economic benefit, and in Spain, levels of corn borer are considered "high" in only around 25% of the corn growing area.[42] Moreover, according to Germany's largest farmers organisation, no insecticide is needed to control the corn borer, since simple tillage is sufficient to control the pest.[43]

In developing countries, where pest management is particularly challenging, a survey by the Maharashtra government, India, in 2003, showed that compared to popular high yielding hybrid varieties of non-GM cotton, GM cotton did not offer an advantage, for it even produced lower yields.[44] Initial economic benefits, in terms of savings in insecticide use, have also shown to dissolve as pests' tolerance to the insecticide increased and additional insecticide-use was required, as has also been the experience of Chinese farmers.[45]

The industry has also claimed reduction in insecticide usage, up to 15%, for bollworm resistant GM cotton. However, farmers have had to modify their pest management since other pests, previously controlled by broad-spectrum insecticide programmes used on conventional cotton, have become more problematic in GM cotton. Additionally, the bollworm itself is slowly developing resistance to the insecticide, causing additional applications of the pesticide to become necessary.[46]

Although first-generation GM crops, such as those described above, address production conditions, such as insect and weed control, and are not intended to increase the intrinsic yield capacity of the crop, studies on GM crops in the US have found that lower yields, along with the higher cost of GM seeds and lower market prices paid for GM crops, are resulting in little or no benefit for farmers.[47] The UK's National Institute of Agricultural Botany found that yields of GM winter oilseed rape and sugar beet, for example, were 5-8% less than conventional varieties.[48]

One may conclude therefore that, not only the degree of innovation and new product development has been very limited, and far from the industry's initial claims and promises, but the achievements of the products that have made it into the market so far have been poor, if not even counter-productive. As the European Commission itself noted, *"the adoption of modern biotechnologies by various European sectors may be lower than anticipated."*[49]

box 2: The industry's inflated claims

In January 2007, Friends of the Earth International revealed how the agricultural biotech industry had inflated its claims on the success of its performance. The biotech industry and other industry-sponsored organizations like ***The International Service for the Acquisition of Agri-biotech Applications (ISAAA)*** claim that the first decade of GM crops has been a clear success for farmers around the world. According to ISAAA, 8.25 million farmers – 90 % of them in developing countries – have chosen to plant biotech crops, and as a result have reduced pesticide applications, decreased production costs, and enjoyed higher yields and greater profits. In their view, *"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"*.[50]

Monsanto makes similar assertions, claiming that over the past decade, farmers have *"increased [the] area planted in genetically modified (GM) crops by more than 10 % each year."*[51] However, ***criticism of Monsanto's claims and the methodology and sources used by ISAAA has been increasing in recent years.*** ISAAA has not publicly announced the source of its information in any of its annual reports since 1997 but, in its 1996 report, ***ISAAA acknowledged that its statistics, particularly for developing countries, are largely gathered "through informal contacts".***[52]

Analyses by several authors have found ISAAA data on biotech crop area to be vastly inflated. Hectare figures are very difficult to estimate accurately without proper official sources, and many governments in developing countries neither keep track of nor monitor the areas planted with GM crops. As a result, verified official statistics cannot be obtained from countries such as South Africa, the Philippines and Brazil. However, ***ISAAA's 2002 report estimated that South Africa had 100,000 hectares of biotech crops, which, for example, was 20 times higher than the figure provided by other biotech industry organizations.*** In the Philippines, ISAAA claimed that it had obtained the figure for the area planted with biotech crops from the government, but the Department of Agriculture there denied that it kept such statistics and one official rejected ISAAA's estimate as superfluous. Even in the United States, it has been reported that ISAAA inflated the figures for GM crop cultivation between 2 and 9 % from 2000 to 2004.[53] Regrettably, the European Commission's Joint Research Centre, responsible for carrying out the cost-benefit analysis of biotechnology in view of the mid-term review of the EU's biotech strategy, has also based part of its evidence on ISAAA's data – see Box 2.

1.2. The socio-economic implications of agricultural biotechnology

The following section assesses the impacts of agricultural biotechnology on the competitiveness of its industry, its contribution to economic growth in Europe, including its implications on employment, investment and industrial performance.

1.2.1. Implications on the competitiveness of EU industry

"The USA is the largest biotechnology power in the world. The best that European national pretenders can hope for is a distant second place."[54]

Critical I, 2006

As Box 1 illustrated, the European Commission and EU member states have provided much financial support to the biotech industry. As a result of this, Europe is now home to 1976 companies (2003), over 1000 companies more than the US. However, despite boosting fewer biotech companies, the US biotech industry outperforms by far its European counterpart, as illustrated in Table 2 and as commented by the industry itself: *"European biotechnology even when taken collectively does not "compete" with the US sector in the sense of being on a par with it by any measurable value with the exception of company numbers. National biotechnology efforts in Europe similarly cannot match up to that of the USA: the largest single national sector – that of the United Kingdom is equivalent to around 10-12% of the US sector, by measures ranging from number of employees, to R&D effort, to revenues and venture capital raised."*[55]

table 2: European vs US biotech industry-performance

Europe's biotech industry (2003)	US biotech industry (2003)
1976 companies	1830 companies
132 new companies	83 new companies
€19 billion revenue	€42 billion revenue
€750 million (raised) in Venture Capital	€2.1 billion (raised) in Venture Capital

source Critical I, 2005. p.4.

Overall, the European biotech industry as a whole, and particularly with reference to agri-biotechnology, appears to have performed very poorly. Shares in 2003 saw the European stock market closed to agricultural biotechnology. Sinclair Pharma, a UK based therapeutics company, was the only European biotech company who managed to raise new capital in 2003 (€12.6M). Although ***in 2004 15 European biotech companies managed to float back on to the stock exchange, with a total of more than €414 million raised, in comparison US companies raised 40% more funds than their European counterparts (€ 1.27 billion) and, again, none of the 15 European biotech companies were agricultural biotech companies, for they were all involved in therapeutics.*** Similarly, of the total funds raised in 2003, US companies accounted for 83% of the equity finance[c], whilst Europe's accounted for just 17%. In 2004 the picture was pretty much the same.[56]

Not only the European biotech industry is performing poorly on the world's stock markets, it is even losing revenues. European companies, covered in the pan-European survey carried out by Critical I on behalf of the biotech industry, reported total revenues of €18.5 billion in 2003, representing a 3% decline on the previous year's revenue.[57] With particular reference to agricultural biotechnology, sales were up in the US by 14% at €3.7 billion, whilst in Europe the revenue slippage was of 2%.[58] It is not surprising therefore that ***not a single one of Europe's "elite" biotech companies is involved in agricultural biotechnology.*** Consumers' attitude to GMOs has been determinant to the success of the technology's commercialisation in Europe. Labelling requirement have meant that consumers in Europe have a right to chose what they eat and, as the most recent Eurobarometer survey has shown, although most Europeans appear to be supportive of technology in general, 58% still oppose the idea of GM crops, and have done so consistently for the last 10 years.[59] As a consequence of this market failure and the lack of tangible benefits, European farmers have not adopted the technology, for only 55.000 hectares of GM crops are grown in Europe – see Box 6 – against the 50 million hectares grown in the US.

This is not to say that in the US agri-biotechnology is proving a successful industry – see Box 3 for a brief analysis of the socio-economic implications of US agricultural biotechnology. In the US, as in Europe, the greatest contribution to the growth in biotech revenues comes from the healthcare sector and those commercialising biotech drugs, in particular.[60] Indeed, ***in Europe, the agricultural biotech sector represents just 7% of the total European biotech industry, with healthcare and the service industry making up over 85% of the biotech industry in Europe.***[61]

As noted by Critical I's survey of biotech companies in the US and the EU, venture capitalists tend to invest in companies with a human healthcare therapeutic and diagnostic focus, accounting for more than 90% of the sums put to work in 2003. Technology service providers, such as companies offering high throughput screening or medicinal chemistry services, attracted 8% of the venture capital (2003), whilst companies focussed on agricultural biotech received less than 1% of the biotech's venture funding (€ 5 M). However, given the different regulatory framework and public acceptance of biotechnology in the US and the EU, the poor performance of the agri-biotech industry suggests a ***general failure of the sector to deliver any valuable products.***

c *Equity finance:* Equity finance is share capital invested in a business for the medium to long term in return for a share of the ownership and, sometimes, an element of control of the business.

Agricultural biotechnology and the Lisbon Agenda – coherent or contrasting strategies for Europe?

box 3: Agricultural biotechnology – not such a success for the US biotech industry

Although in the US agricultural biotechnology has proved more successful than in Europe, it is important to note that the agri-biotech industry is beginning to face a number of challenges. Anticipating significant returns from both agricultural and pharmaceutical biotechnology, few large firms have acquired smaller biotech start-up firms (and their biotech patents) in the 1990s and transformed themselves into large "life science" companies.

While some pharmaceutical firms have since divested their agricultural holdings after failing to realize adequate returns on their investments in the field of agricultural biotechnology, large agricultural biotechnology companies, like Monsanto, have maintained agbiotech research and development programmes.[62]

The consolidation in the agricultural biotechnology industry is thought to be hindering market competition. Although, in theory, market concentration realizes economies of scale, which can improve market efficiency by driving down production costs, whilst the protection of intellectual property rights stimulate research and development, recent data on mergers, acquisitions, and strategic collaborations in the agricultural biotechnology industry, as well as the emergence of life science conglomerates, indicate a possible hindering of the market for innovation and competition, calling into question the viability of these conglomerates. Competitive markets are an important incentive for efficient aggregate production, and prevent distortions that result in inequitable allocation of economic benefits. To date, just 10 firms in the US accounted for almost half of the observed mergers, acquisitions, joint ventures, and strategic alliances.[63]

Concerns are also being raised with reference to employment implications of the biotech sector. After a tough round of restructuring in 2002, the US biotech sector looked well on the road to recovery in 2003 with a 3% year-on-year increase in total employment levels.

However, while 45% of US biotech companies surveyed by Critical I revealed that they increased their headcount during 2003, restructuring had not been completed, and 26% of companies employed fewer people at the end of 2003 compared with the start. Much of the restructuring that continued on from 2002 was associated with refocusing from discovery platforms towards later stage product developments. This had a major influence on the numbers employed in R&D, which dropped by 6% in 2003 (73,520 jobs).[64]

When considering the US agribiotech sector, it is also worth noting that in the US as in other parts of the world, very few GM varieties are being grown commercially. In the US, as of November 2006, 70 distinct biotech 'events' had been approved for commercial use but only 4 crop with 2 traits are infact being grown.[65]

1.2.2. Implications on industrial/product development

According to the findings of Critical I's assessment of the biotech industry in 9 European countries in 2003, 150 companies disappeared from the landscape as a result of merges and acquisitions (M&A) that took place that year between the larger biotech companies. Although not all M&A activity results in companies disappearing, as the prey companies are sometimes maintained as operating subsidiaries, the market is concentrating in the hands of fewer players as companies attempt to expand their ownership over the production line and knowledge capital.[66]

Britain's biotech sector witnessed some major upheavals in the past two years with some very high profile mergers and acquisitions.[67] Monsanto recently announced of its intended acquisition of the leading cotton-seed company Delta and Pine Land Company for $1.5 billion.[68]

The economic benefits of biotech seed sales are almost exclusively within the large corporate seed sector. This is being achieved not by revolutionary innovation and the marketing of new GM crops that meet farmer or consumer needs, but by establishing market control through economic measures. ***The actions of the European Union, European Patent Office and the US Patent Office in increasing the scope of intellectual property rights to include plants, has been fundamental in altering the shape of the seed industry.***

Research in the United States, using data from patents, field trials, and applications to deregulate GM crops (equivalent to marketing consent in Europe) indicates that the consolidation that has taken place had led to a trend towards negative impacts on innovation.[69] Indeed, through a series of mergers and acquisitions, in 2002 the "Big Six" companies, Monsanto, Dow, Dupont, BASF, Bayer and Syngenta, owned 40% of US agricultural biotechology patents on both key genes and transformation techniques.[70] Monsanto is now responsible for almost 90% of all GM traits world wide. It has more GM product applications for commercial release than any other company, either directly or indirectly through licensing agreements with local seed companies.[71]

This illustrates how ***investment in biotechnology is unlikely to lead to innovation and new product development, but increasing market concentration of the seed industry in the hands of just a few large multinational, a squeezing out of competitors, the neglecting of smaller markets and a decrease in knowledge development.***

1.2.3. Implications for employment

"By keeping Europe at the cutting edge of biotechnology research, we will also contribute to the more general goals of creating more highly-qualified and well-paid jobs, boost economic growth and improve our terms-of-trade."

Günter Verheugen, European Commission Vice President, Press Release, 2005

"Statistics on biotechnology employment cannot be obtained from official sources [...] because standardised data collection is not available for this industry that stretches across several industrial sectors. Some data is available, but mainly categorised in employment per Member State, not per biotechnology sector (white, green and red), which is a less than precise definition."

Günter Verheugen, European Commission Vice President, written response to parliamentary question, 2006

In 1999, the biotech sector counted 536,000 employees in the European Union (EU) – slightly less than 0.4% of total employment in the EU 15.[72] At the time, biotech supporters, including the European Commission,[73] believed that ***the greatest economic and employment impacts of biotechnology were likely to occur in the agro-food production chain, and that investment in the sector would lead to millions of jobs being created in Europe.***[74]

European Commissioner Verheugen has been very vocal about his enthusiasm for agricultural biotechnology's implication for employment in Europe, however, as illustrated in the quotes above, he himself admits that data necessary to substantiate such claims are not easy to find. Indeed, and regrettably, this is the case, though the few ***data produced by academia and the industry itself suggests that the biotech sector has had a negative impact on job creation in Europe.***

MERIT, the Economic and Social Research centre on Innovation and Technology of the University of Maastricht in The Netherlands, surveyed, in 2002, several industry data sources to estimate the potential impact of innovation in agro-biotechnology on employment in the European agro-food chain. The analysis found that *"four of the five main innovation strategies for new plant varieties are likely to reduce indirect employment, but the fifth, improved quality traits (such as enhanced oil content), could increase employment by creating higher value-added crops, although there will be job losses in industrial processing."*

However, it specified that *"[f]ield test data for Europe and the United States show [...] that there has been no detectable shift in agro-biotechnology innovation towards quality traits."*[75] Indeed, as illustrated in the previous section, the quality of the traits produced so far has been very disappointing, even by the industry's own standards and expectations. Moreover, the study informs that *"[t]he analysis assumes that European farmers are free to grow approved genetically modified (GM) crops and that there is minimal public opposition to GM foods,"* an assumption that the authors of the study themselves acknowledge being *"currently unrealistic."*[76] Despite this biased assumption, the study concludes the agricultural biotechnology will exert a negative trend on employment in Europe.

Many economic analyses assume that product innovation generally increases employment (ie.: new products), whilst process innovation decreases it (as a result of more efficient production mechanism and less input required). However, it is theorised that the loss of employment in the processing sector can be offset through (a) increased quality of the products, (b) increased exports, and (c) consumers' positive response to a process-induced fall in prices.[77, 78, 79]

However, as discussed earlier, to date, the quality of the products has been unsatisfactory. Moreover, as the most recent Eurobarometer has pointed out, 58% of Europeans still strongly oppose food biotechnology, causing the GM market to be virtually absent in Europe, whilst the negligible adoption of GM crops by European farmers – see Box 6 – has also meant that exports of GM crops from Europe are also virtually non-existent. This undoubtedly suggests that food biotechnology will cause jobs to be lost in the processing sector.

With reference to the assumption that innovation increases employment, recent industry data suggests that the agri-biotech sector might well be the exception to the rule.

According to the biotech industry itself, *"[e]ven though there have been signs that investor enthusiasm for biotech has been returning steadily since the collapse in 2001, company managements have been forced to focus on cash burn rates and conserving cash resources. The result was approximately one in four companies laying off significant numbers of staff, [...] in the past three years, with smaller and less mature companies faring worse."*[80]

Agricultural biotechnology and the Lisbon Agenda – coherent or contrasting strategies for Europe?

With reference to the agricultural biotech industry alone, it is estimated that the sector experienced the "largest proportional decline in employment" out of all biotech sectors. The same applies with reference to R&D employment, which has declined by 5% between just 2002 and 2003 – that is approximately 1500 jobs lost in just one year.[81] According to the industry, even the most successful biotech companies have been forced to lay off staff in order to meet profit margins.[82]

In Germany, three out of ten (30%) German biotech companies appear to have reduced staffing levels. ***Although Germany had only two companies less in 2003 than in 2001, there was a 7% decline in total employment between 2002 and 2003, accounting for 17,200 jobs lost in just one year. The number of research staff in German companies also fell by 6%, some in an attempt to meet profit targets.*** With reference to the agricultural biotech sector, it is estimated that the sector employs just 500 people in the whole of Germany.[83] Similarly in France, 17% of biotech companies cut employment during 2003, despite an overall employment growth of 5% in the sector. Jobs have been lost in Europe also as a consequence of many biotech companies relocating abroad, especially to the US, partly as a result of the strengthening of the British pound and the Euro against the US dollar.

Additionally, and bearing in mind what discussed in the previous section, the large number of mergers in both the seed and agro-chemical sectors in the last decade has also reduced employment. As an example, ***the 1999 merger of Rhone-Poulenc and AgrEvo to form Aventis reduced employment by 3000–4000 jobs,*** with the closure of an R&D centre in the UK and a European agro-chemical manufacturing plant.[84]

Organic Farm shop in the UK.

1.2.4. Implications for agricultural economy

As reported in Box 6, in Europe only a small area of agricultural land is used for GM plantations, and again, when compared to the 50 M hectares grown in the US – representing 55% of the world's total land planted with GM crops – or Argentina (17 M hectares) and Brazil (10 M hectares) – the three of them representing 85% of the 90 M hectares grown worldwide – the European share of GM farmland becomes negligible.[85] Moreover, most of the GM crops grown originally intended for human consumption, have now been destined to animal feed, which has decreased substantially the value of the crops. The shift has taken place as a result of a lack of labelling requirements in Europe for products derived from animals fed on GM feed.

Hence, ***with the exception of animal feed, Europe represents a loosing market for GM farmers.*** According Australia's Rural Industries Research and Development Corporation (RIRDC), *"the US share of EU's maize imports has fallen to virtually zero (from around 2/3 in the mid 1990s), as has Canada's share of EU canola imports (from 54% in the mid 1990s). GM-adopting countries are increasingly losing market share to GM-free suppliers"*.[86]

Indeed, since 1997, the European Union has effectively barred US corn imports over the possibility that GM varieties, unapproved in the EU, mixed with sanctioned crops. This has cost American farmers an estimated US$200 million a year in export losses.[87] The strong opposition by European consumers to GM foods has meant that farmers in Europe are staying away from GM crops and, as the next chapter discusses in more detail, GM-free farming, and organic farming especially, is growing rapidly in Europe as a safer, more reliable, and increasingly profitable activity for European farmers to invest in.

The technical and financial risks involved in GM farming and the serious threat that it poses to non-GM farmers is illustrated by the recent scandals of unauthorised US GM rice found in markets worldwide – see Box 4.

box 4: The hidden costs of biotechnology – the case of LLRICE 601 and StarLink corn

"It is difficult to appreciate the efficiency of the measures [taken to ensure that the EU public does not buy contaminated rice] since import has virtually stopped"

EU's Standing Committee on the Food Chain and Animal Health, January 2007

LLRICE 601 On August 18th 2006 US Agriculture Secretary Mike Johanns announced that US ***commercial supplies of long-grain rice had become inadvertently contaminated with a genetically engineered variety not approved for human consumption.*** The variety, known as LLRICE 601, was produced by biotech company Aventis (now Bayer), who stopped field tests of LLRICE 601 in 2001. However, the contamination appeared in the 2005 harvest and the US agency first learned about it after "trace amounts" were discovered during rice industry testing of commercial supplies. ***Contaminated long grain rice has been found in at least 17 European countries*** to date.[88] In Germany, according to the Baden-Wuerttemberg ministry of agriculture, LLRICE 601 was detected in 7 out of 46 retail supplies tested, which had to be immediately removed from the shelves.[89] Prior to the contamination, rice exports in the US were worth about US$1 billion a year, but rice futures plummeted immediately by US$150 million following the contamination announcement. The United States accounts for 12% of world rice trade, but since 75% of US rice crop is long grain (the type contaminated) ***it remains unclear the extent of the damage caused to US rise exporters*** as Europe, and many other countries, close their markets to US imported rice. The US was expecting to produce a rice crop valued at $1.88 billion in 2006. As a result, rice ***growers in Arkansas, California, Louisiana, Mississippi, Missouri and Texas are now suing Bayer for economic losses.***[90] The political and economic impact could rival or exceed that of the last such major event – the discovery in 2000 that the US corn supply had become contaminated with StarLink corn – which cost US farmers an estimated US$500 million in sale losses to domestic and foreign markets.

StarLink corn In mid September 2000, ***traces of the Aventis GM corn (marketed as StarLink) were identified in taco shells manufactured by Kraft Foods and distributed through the fast food chain,*** Taco Bell. This occurrence represented a significant challenge to the existing grain production, handling, and processing sector since this biotech product was not approved for use in grain products for human consumption. The incident led to the recall of nearly 300 food products – including more than 70 types of corn chips, more than 80 kinds of taco shells, and nearly 100 food products served in restaurants – by several food manufacturers and caused major disruptions in domestic and export markets. Recently, StarLink was found in more corn products, including bread, polenta, and hush puppies. The United States is the world's largest producer and exporter of corn, accounting for about 40% of global output and 65% of world corn exports. U.S. corn growers produce about 9.5 billion bushels per year worth more than US$17 billion. ***The estimated 6% drop in the price of corn translated into major financial losses to the non-StarLink corn growers.***[91]

As the LLRICE 601 and StarLink corn incidents illustrate, the economic implications of contamination incidents can be enormous, having serious impacts on the domestic and export-oriented agricultural market, as well as involving high costs for managing the contamination, such as identifying the source, the removal of products from the market and the testing involved.

Due to GM contamination of non-GM products, there has been public investment in developing testing systems and establishing specialist laboratories to test for the presence of GM ingredients and ensure labelling and traceability rules are being adhered to. The EU has established a network of GMO laboratories for this purpose[92] and a community reference laboratory.[93] This is of particular importance because under EU rules products that contain more than 0.9% authorised GM content has to be labelled. Even for the 0.9% threshold to be allowed, producers have to show that the contamination was "adventitious or technically unavoidable".

The burden of ensuring that food is non-GM, or organic, has largely fallen on the producers of such food, not the GM-crop producers. However, in some European countries, under coexistence rules, GM farmers may be liable for contamination and economic losses incurred by non-GM farmers. The current multi-million dollar class-action lawsuits filed by about 300 US rice farmers against Bayer, who produced the GM rice LLRICE 601[94]– see Box 4 – raises a number of issues, such as who will be liable – for several companies might be involved in the production process – who can claim, what can be claimed and under what circumstances and whether there is a compensation fund or insurance to cover any claims?

Surveys conducted in 2003 found, however, that the insurance industry is not willing to provide coverage for farmers growing GM crops.[95] This might pose a serious problem to European farmers since, ***according to a report recently released by the European Parliament, "it is unlikely that, if GM crops were to be grown in any European country on a large scale, cross-pollination or seed dispersal from GM-crops can be prevented."***[96]

With the recent inclusion of Romania to the Union, the threat of its uncontrolled GM soya farming, and its non-compliance with EU legislation (the cultivation of genetically modified soya is not authorised in the EU), will see Romania's soybeans restricted from entering EU markets and possibly the country's access to structural funds for agricultural projects being restricted.[97] It is important to note, in this context, Europe's position *"on the need to safeguard Europe agricultural practices"*[98] from GMOs, which ***raises the question of how to apply the polluter pays principle to GM contamination*** – see Box 5.[99]

Agricultural biotechnology and the Lisbon Agenda – coherent or contrasting strategies for Europe?

box 5: Polluter Pays in Principle...

Any operator wishing to avoid positive GM labelling of ingredients, additives and enzymes derived from crops that may have a GM origin will have to set-up systems and records to ensure that only ingredients derived from non-GM origins are used. Similar requirements will apply to imports of finished products from third countries where raw materials derived from GM crops are widely used and, in particular, those countries where segregation of GM and non-GM materials is not widely practised.

In order to continue to apply "GM avoidance" policies, many businesses will therefore have to extend their ingredient / product procurement procedures to ensure that products comply with the new labelling threshold for non-GM products. In general, the incentive for any non-GM supplier or buyer to implement new measures to comply with the new legislation is directly influenced by the relative costs involved compared to the consequences of not complying (e.g. possible loss of non-GM price premia, or the inability to sell the supplies labelled as containing/derived from GMOs in a given (non-GM) market).

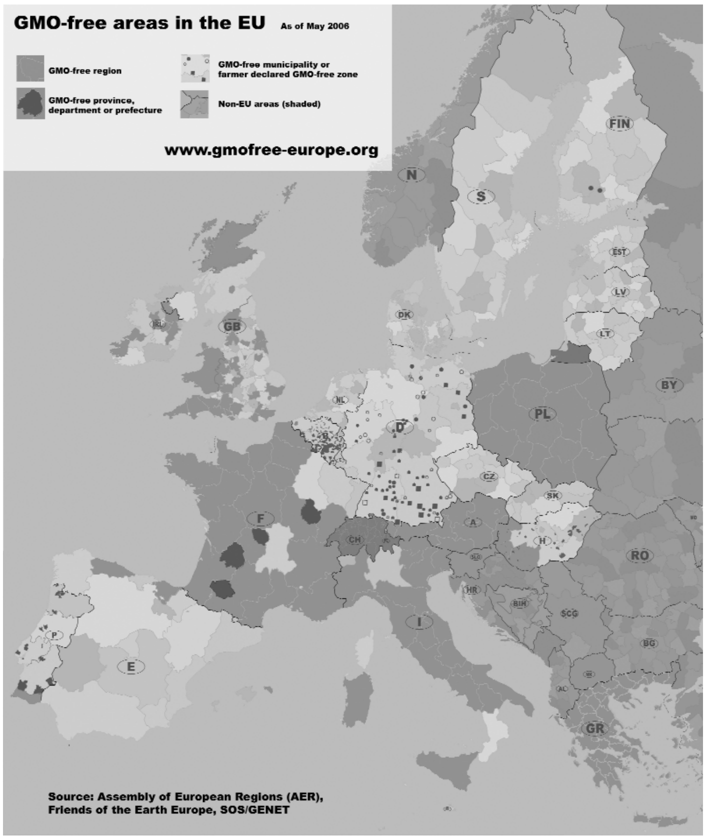
Where the consequences of exceeding the thresholds for adventitious GM presence or having to identify known GM ingredients are significant, then suppliers are usually more prepared to make changes to their raw material procurement systems and incur the associated costs. Where the adventitious presence threshold applied has been 1% (for the presence of GM material), price differentials have tended to be in the range of 2% to 5% (i.e. non-GM soy has traded at a higher price than GM soy). When tighter thresholds and a stricter regime of testing, traceability and guarantees are required (e.g. to a threshold of 0.1%), the price differential has been within a range of 7%-10%. The additional cost burden of supplying non-GM ingredients has largely been absorbed by the supply chain up to the point of retailers.

This raises the issue of how to apply the "polluter pays" principle in this instance, which is referenced to in several official EU pieces of legislation, such as the Sustainable Development Strategy. ***At present the burden of proving that one's produce is GM-free, and the costs involved in doing so, rest on the non-GM farmers. However, according to the Polluter Pays Principle, the costs should be incurred by the GM farmers causing "pollution" of non-GM farmers' crops.***[100]

Given these socio-economic implications of agricultural biotechnology, it is not surprising therefore that local opposition to GM crops has grown over the years. To date, 172 European regions and 4,500 other zones (villages, local authorities, etc) have declared themselves GM-free regions – see Fig. 1. In the case of Poland, parliament recently passed a total ban on cultivation of GM crops by prohibiting registration of GM seed varieties.[101]

The call for similar approaches is reaching far beyond Europe. The Indian government has recently advised its industry to stay GM-free given the little market for transgenic crop commodities. Due to India's ability to certify its soya as GM free, India has a trade interest to remain GM-free, given its competitive market access to Korea and Japan.[102] Similarly, the British Retail Consortium (BRC), the main trade association for UK retailers, has called on the Brazilian soy industry to *"resist further growth of GM planting"* because *"it will be enormously difficult to maintain trust in the food chain should Brazil's supply of non-GM soybean dry up."*[103] The statement comes as important decisions are being made by Brazilian farmers about whether to plant GM or non-GM soya for the next season's crop. It represents a strong re-affirmation that the UK retail industry wants to continue to provide GM-free products to UK consumers.[104]

figure 1: GMO-free areas in Europe (EU-25)



source www.gmofree-europe.org/

box 6: Agricultural biotechnology in Europe[105]

GM crops in Europe represent 0.5% of GM crops planted worldwide, and just 0.03% of the EU's UUA.[106] To date, there is just one major GM crop produced in the EU, and that is GM maize in Spain. However, other EU member states are growing GM crops, to a smaller scale, for commercial purposes. These are listed below and figures are based on the industry's own data. Regrettably, these are the only comprehensive data provided. However, it is interesting to note how, although as argued in Box 2 the ISAAA's estimates have been found to be vastly inflated, ***the area of agricultural land planted with GM crops still appears negligible:***

Spain – 53,000 hectares of GM maize were grown in Spain in 2005. This is the only EU country to grow GM crops to any significant scale. Even so, FAO figures indicate that this only corresponds to 12.5% of the total surface area under maize cultivation in Spain.

Germany – has grown GM maize for several years but to a limited extent. Indeed German farmers have established GMO free areas that cover a total surface area of 877 000 hectares.[107]

France – resumed planting of GM maize in 2005 after a four-year gap. France planted GM maize in 1998 (1,500 hectares), 1999 (150 hectares), and 2000 (<100 hectares). In 2005, approximately 1,500 hectares were planted of which 200 hectares were for environmental monitoring, 100 hectares for experimental use, and 200 hectares for purely commercial purposes. The residual 1000 ha was not classified but was largely shipped to Spain and mixed with Spanish GM maize. In 2006 approximately 5000 ha of GM maize were planned to be sown resulting in protests from farmers and citizens. Calls for a moratorium on this GM maize are gathering political support.

Portugal – Portugal resumed planting of GM maize after a five-year gap. Portugal planted an introductory area of approximately 1,000 hectares in 1999 for one year. In 2005, approximately 750 hectares were planted to GM maize and an estimated 1000 ha was sown in 2006.

Czech Republic – The Czech Republic approved the commercial production of a biotech crop for the first time in 2005 and grew 150 hectares of GM maize. It is estimated that approximately 600 ha were sown in 2006. The Czech Republic is increasing its maize area in order to reduce the need for maize imports. In 1999, the Czech Republic imported 76,000 MT of maize while in 2004, it was only 10,000 MT. Over 90% of total imported maize comes from Slovakia.

1.3. Agri-biotech policy: a case of regulatory capture?[d]

"It is my objective to ensure that we create the conditions so that Europe, becomes the natural home for biotechnological innovation."

Gunter Verheugen, 2005
Vice President of the European Commission

The evidence collected so far suggests that agricultural biotechnology is far from delivering, or contributing even, to the objectives of Europe's strategy on competitiveness. However, the European Commission, and Commissioner Verheugen in particular, have been very vocal about their support for the biotech industry.

Given that most of the evidence here gathered is official data from either the European Commission or the industry itself, it is puzzling that the former should be so biased in favour of the latter. Is the Commission unaware of its own data, or that of the industry's? A closer look to the bodies advising the European Commission on issues related to biotechnology might provide some explanation for this apparent inconsistency between the evidence and the claims.

Within the European Commission there are a number of advisory bodies charged with overseeing and inputting into biotechnology-related policy. The main ones are listed in Table 3 and, with the exception of the Biotechnology Steering Group, which is an "inter-service" group, meaning that its members represent Commission officials from a number of directorates with a direct interest in biotechnology[108] – the other bodies' membership is composed predominantly, if not exclusively, by industry, particularly the largest biotech companies.

d *Regulatory Capture:* Bernstein (1955), Sabatier (1975) and Mitnick (1980) referred to "regulatory capture" as a phenomenon characterised by regulatory agencies becoming dominated by the companies/industry that they are supposed to control. Such theorist argue that regulators are often dependent on the industry for information, knowledge and even the means of assessing that information. Likewise, they also assume that industry may selectively supply information to regulators in an attempt to persuade regulatory agencies to share corporate perspectives and conclusions.
Bernstein, M. H. "Regulating Business by Independent Commission." 1955.
Princeton: Princeton University Press.
Sabatier, P. "Social Movements and Regulatory Agencies: Toward a More Adequate - and Less Pessimistic - Theory of "Clientele Capture"", Policy Sciences, Vol. 6, 1975
Mitnick, B. M. "The Political Economy of Regulation: Creating, Designing, and Removing Regulatory Forms", Columbia University Press, New York, 1980.?

Agricultural biotechnology and the Lisbon Agenda – coherent or contrasting strategies for Europe?

table 3: Key advisory bodies to the European Commission on biotech policy

Name of group	Membership	Competencies	Chair/coordinator
Competitiveness in Biotechnology Advisory Group	Industry / Academia	Competition policy	Europabio (Biotech industries lobby group to the EU)
Biotechnology and Finance Forum	Industry	Financial issues	European Association of Securities Dealers (Industry)
Biotechnology Steering Committee	European Commission	Overall policy coordination	European Commission
Plants for the future – Technology platform	Industry / academia	Policy recommendations	Europabio (Biotech industries lobby group to the EU)

Amongst the most influencial advisory bodies is the ***Competitiveness in Biotechnology Advisory Group (CBAG)***, set up in 2003 as part of the EU Biotech Strategy and charged with making recommendations to the Commission on how to improve the competitiveness of the biotech sector in Europe. The CBAG has been particularly adamant about the importance of ensuring widespread political and financial support for the biotech industry across Europe. In a recent report assessing the EU biotech strategy, the CBAG claims that *"the lack of conviction by some decision makers about the important social, financial, health, and environmental benefits that life science knowledge makes possible has held back progress"* and recommends that *"reluctant Member States [are] encouraged to integrate the strategy in their policies."*[109] *For the CBAG the issues at stake is "to convince latecomers to put their efforts into deciding HOW instead of WHETHER to implement the European strategy."*[110]

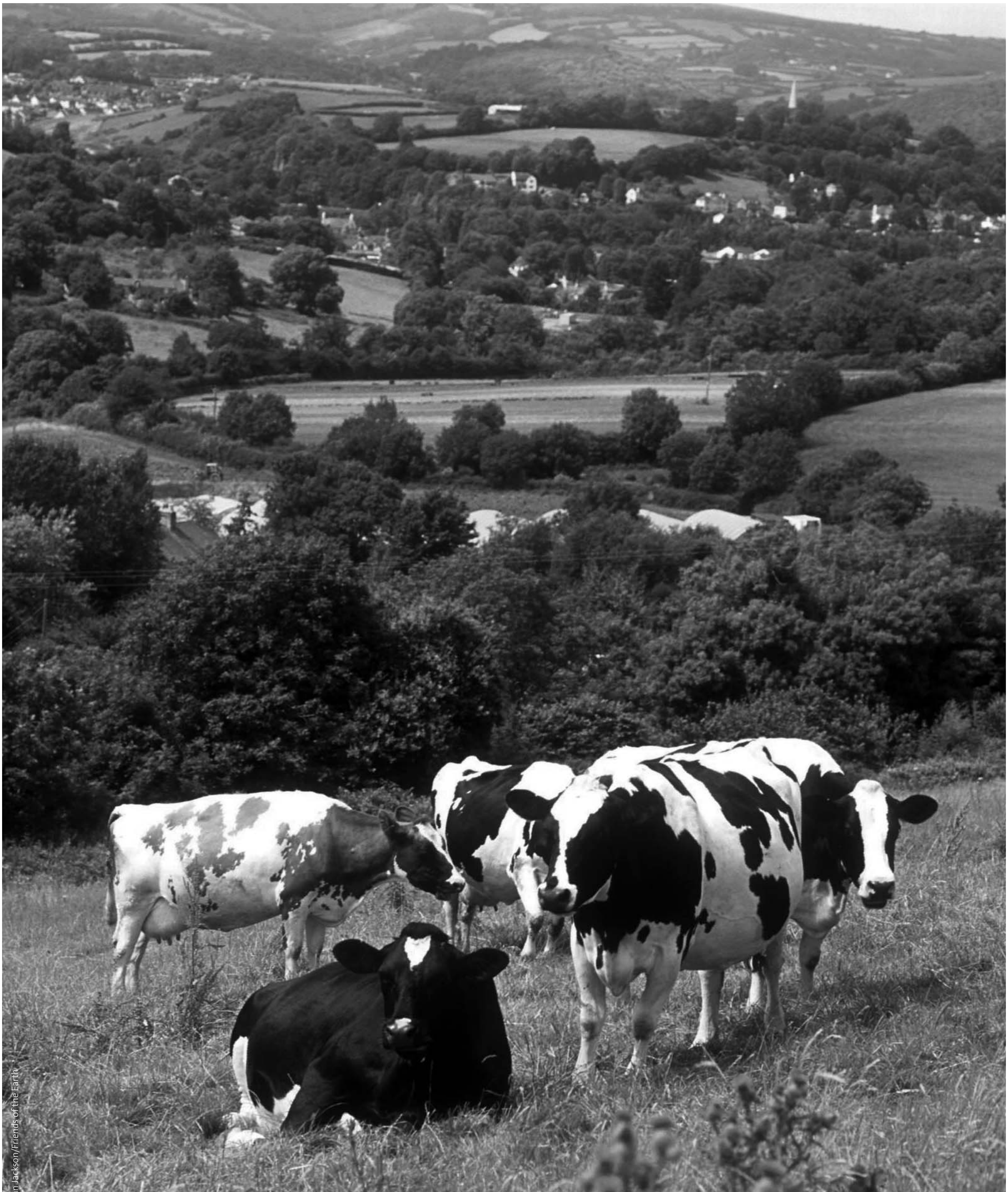
Unsurprisingly, the CBAG is chaired by Europabio, the biotechnology industries lobby group in Europe, whose direct interest is, goes without saying, to get the widest possible political and financial support by regulators in Europe for its industry. In its very first report, the CBAG made it very clear that its focus would be centred on issues related to finance and regulation, particularly the issues of (i) ensuring the protection of the industry's property rights; (ii) further financial support for the biotech industry in Europe; (iii) increase the funding for private/public research partnerships.[111]

The European Commission appears not to have questioned the validity of the recommendations, for in its own recommendations put forward to the Parliament, the Commission stated that: *"Public and private investments in research urgently needs to be increased. There is a need to continue to improve biotechnology companies' access to finance."*[112] By basing policy choices on the industry's own advice, is the European Commission being captured by the interests of the very same industry it is supposed to regulate?

The questionable assumptions on which the European Commission's Joint Research Centre's (JRC) is basing its cost-benefit analysis of Europe's biotech strategy suggest that it is. Friends of the Earth Europe has already raised a number of questions concerning the independence of the analysis. The key issues are reported in Box 7.

Organic Agriculture in the UK.

1



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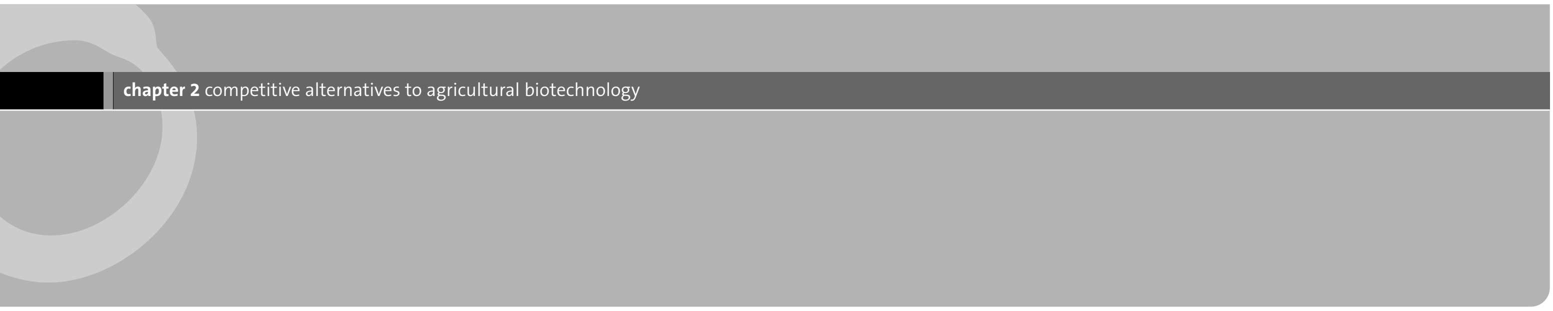
Competitive alternatives to agricultural biotechnology

2

Although non-GM farming includes a variety of agricultural practices, this chapter is concerned with looking at alternatives to GM farming that are environmentally friendly as well as economically viable. Consequently, conventional farming, which requires large use of chemicals (pesticides, fertilisers, etc), monocultures, and the presence of large agri-businesses, will not be considered in this chapter as a desirable alternative to GM farming. Based on the EU's commitment made in Goteborg in 2001, and its 2003 reformed Common Agricultural Policy (CAP), this chapter will consider sustainable farming practices falling under the EU's Rural Development policy.



2.1. Rural Development and sustainable agricultural practices

> *"Strong economic performance must go hand in hand with the sustainable use of natural resources and levels of waste, maintaining biodiversity, preserving ecosystems and avoiding desertification. To meet these challenges, the European Council agrees that the Common Agricultural Policy and its future development should, among its objectives, contribute to achieving sustainable development by increasing its emphasis on encouraging healthy, high quality products, environmentally sustainable production methods, including organic production, renewable raw materials and the protection of biodiversity."*[113]
>
> **European Council**
> **Presidency Conclusions, Goteborg 2001**

Rural development is closely linked to the Common Agricultural Policy and measures to support employment in Europe. Rural development has become the second pillar of the CAP despite resources being relatively minimal compared to those allocated under pillar I (production based).

With its links to agricultural activities and conversion, rural development is concerned particularly with the following practices:

a) modernisation of farms;
b) safety and quality of food products;
c) fair and stable incomes for farmers;
d) environmental challenges;
e) supplementary or alternative job-creation activities in a bid to halt the drift from the country and to strengthen the economic and social fabric of rural areas;
f) improvement of living and working conditions, and promotion of equal opportunities.[114]

The core of the Community's environmental strategy within the CAP has been the application of the targeted agri-environment measures throughout the territories of the Member States. The agri-environment programmes offer payments to farmers who, on a voluntary and contractual basis, provide environmental services to protect the environment and maintain the countryside.

These services aim to improve the quality of life in the countryside and can contribute to the diversification of economic activities, in particular through tourism.

About one third of the Community contribution to rural development (EAGGF - European Agricultural Guidance and Guarantee Fund) has been spent on agri-environmental measures (4% of the total CAP budget) and across the EU, the share of agricultural land enrolled in agri-environmental measures in total agricultural area has increased substantially – see Box 8.

Agri-environmental measures support specifically designed farming practices that go beyond the baseline level of "good farming practice" (GFP) that help to protect the environment and maintain the countryside. Examples of these include:[115]

- environmentally favourable extensification of farming;
- management of low-intensity pasture systems;
- preservation of landscape and historical features such as hedgerows, ditches and woods; conservation of high-value habitats and their associated biodiversity.
- integrated farm management;
- organic agriculture.

Of these, the most successful, and well documented, has been organic farming and will be discussed separately. With reference to the other activities, regrettably there are not much data available, but the following section aims to provide a brief overview of the main socio-economic implications of those activities for which data exists.

2.2. The socio-economic implications of agri-environmental measures

It is difficult to quantify the socio-economic implications of environmentally-friendly agricultural production for no exact figures are available. Indeed, the European Council meetings in Cardiff and Vienna underlined the importance of developing environmental indicators, since they could help transform physical and monetary data about human activities and the state of the environment into decision supporting information.[116]

However, according to data provided by the European Commission Directorate for Agriculture, agri-environmental measures have led to quantified reductions in use of inputs, conservation of valuable farmed habitats, and changes in use of land for environmental purposes. The research found positive impacts on biodiversity, landscape, water and soil resources and to a lesser extent air quality.[117] In particular, the European Commission assessment of the socio-economic implication of agri-environmental measures in Europe measured an increase in agricultural work and a substantial increase in work by firms in ***Great Britain.*** The activities of hedging, maintenance of terraces and repairing stonewall involve intensive work needing extra labour.[118] Similarly in the ***Netherlands*** livestock farmers who have signed management contracts need additional labour. This result can be taken as a positive employment effect and testifying that improved environmental management of the land requires additional labour.[119] This growing employment tendency in the sector is particularly positive given the overall decrease in agricultural employment in Europe.[120]

As the economic, as well as social benefits, of agri-environmental farming become apparent, it is hoped that an increasing number of farmers will turn to agri-environmental farming practices. Indeed, as ***a UK-based comparative study revealed by assessing the profitability of nine sites, comparing environmentally-friendly agriculture with conventional farming, the former averages a profitability 2% greater than the latter's.***[121]

Organically grown pumpkin in the Netherlands.

Competitive alternatives to agricultural biotechnology

The overall financial results from Integrated Arable Crop Production Alliance (IACPA) demonstrate that although yields might be lower in Integrated Farm Systems (IFS),[e] compared to conventional farming, lower input use allows for greater profitability. Hence, as grain prices fall, the relative profitability of IFM increases: the integrated system is more resilient and farmers are actually 15% better off than under the conventional system. Trials at Long Ashton, Derbyshire, UK, showed that profitability was maintained, for yields reduced by 12% and production costs by 34%: *"a less intensive, fully integrated systems approach provided economic viability comparable to conventional systems."*[122]

These trends have been confirmed by the Countryside & Community Research Unit of the University of Gloucester, UK, and the Institute of Grassland and Environmental Research, UK, who carried out a comprehensive literature review of the socio-economic implications of integrated farm management.[123] In their assessment they report that a 12-year monitoring experiment on a farm in Lautenbach, Germany, on which economic and ecological effects of IFS and conventional systems were compared, found that, although output was lower in the integrated farm surveyed, the consistently low variable costs produced higher gross margins every year. Lautenbach project yields were lower (approx. 2%) but matched by lower machinery costs (6.8%) and reduced inputs and gross margin about 5% higher. The study established that through savings on variable costs of pesticides and fertilisers the integrated method gave higher net surplus and labour returns.

As the following section on organic farming illustrates in greater detail, rural development policy targeting agri-environmental farming practices in Europe has the potential to reverse the negative socio-economic implications of conventional farming, which wider uptake of GM farming is likely to exacerbate.

box 7: Historical overview of Rural Development funding[124]

The past twenty-five years have seen various reforms to the Common Agricultural Policy (CAP), with a gradual increase in the emphasis placed upon non-commodity aspects of rural land use. The 1992 MacSharry reforms increased the transparency of commodity support by introducing direct headage and area payments – originally intended to be short-term, transitional measures to compensate for cuts to market support. At the same time, agri-environmental schemes were formalised as one of three "accompanying measures" to be funded from the Guarantee section of the European Agricultural Guarantee and Guidance Fund (EAGGF), the same pot of funding used for commodity support.

Agenda 2000 went further, adding area-based Less Favoured Area schemes to the bundle of original accompanying measures but, more radically, consolidating numerous different funding mechanisms under a single framework – the Rural Development Regulation (RDR) – and introducing the concept of the first (commodity production) and second (rural development) pillars within the CAP. The "mid-term review" of Agenda 2000, later renamed "Towards sustainable farming: a long-term perspective for sustainable agriculture", but perhaps more easily referred to as the 2003 Fischler reforms, went further.

The nature of Pillar I support was altered radically by decoupling commodity payments and Pillar II saw an expansion of the number and type of measures eligible for funding, grouped along four "axes", and with an expanded list of "accompanying measures". Significantly, the concept of a single, dedicated Pillar II fund – the European Agricultural Fund for Rural Development (EAFRD) – to replace the mix of EAGGF (with separate Guarantee and Guidance streams), Structural Funds and various other funding streams used to date.

Moreover, EU-wide compulsory modulation was sanctioned as a mechanism for transferring funds from Pillar I to Pillar II. These principles were finally agreed in the second RDR, to cover the period 2007-13. However, whilst former European Commissioner for Agriculture, Fischler, had clearly hoped for increased funding for rural development, his aspirations were overtaken by higher-level negotiations regarding policy priorities, community enlargement and the total EU budget. As a result, €69.25bn went to rural development, against the €88.75bn originally sought by the Commission.

e Integrated farming (or integrated agriculture) is a system of agricultural techniques developed in France in 1993 by FARRE (Forum de l'Agriculture Raisonnée Respecteuse l'Environnement). It is an attempt to reconcile agricultural methods with the principles of sustainable development, by balancing, in the words of FARRE, "food production, profitability, safety, animal welfare, social responsibility and environmental care."

2.3. Organic farming

Organic farming is practiced in almost all countries of the world, and its share of agricultural land and farms is growing. At the end of 2003, organic land area worldwide was estimated at about 26.5 M ha, 69% higher than in 1998. With 6.3 M ha of organic area officially certified[f], Europe ranks third, behind Oceania (11.3 M ha) and Latin America (6.2 M ha) but before North America (1.5 M ha), Asia (0.7 M ha) and Africa (0.4 M ha). ***Europe as a whole represents more than 23% of the world organic area.***[125]

2.3.1. The socio-economic implications of organic farming

In 2000, EU Member States met in Stockholm to agree on a strategy for Europe on Sustainable Development. As a result of the discussion, the European Council concluded that: *"economic growth, social cohesion and environmental protection must go hand in hand."*[126] Although this study is primarily concerned with the objectives set in Lisbon, namely those of economic growth and job creation, this section will assess the socio-economic implication of organic farming in relation to both policy frameworks, that of competitiveness and sustainable development.

Economic implications – Worldwide, the Organic Market Report 2006 revealed that ***in 2005 the market for organic food grew £1.2 billion to £16.7 billion – a rise of 8 %.***[127] According to a new publication of the market research company, Organic Monitor, exceptionally high market growth rates are pushing global organic food & drink sales towards US $40 billion for 2006.[128] ***Demand for organic products has been growing at double-digit rates in many countries across the EU.*** In the UK, the Soil Association, Britain's biggest certification body, reported that sales of organic food leapt by 30% (€ 2 bn) in 2005 – almost treble compared to the previous year. Demand for organic milk was particularly strong, rising by 91% in just a 12-week period (two-thirds of Britain's organic dairy supply comes from the UK's 4,000 organic farms).[129]

Organic food production has been considered by many as a success in EU agriculture with the area of land devoted to organic production rising from 0.7 M hectares in 1993 to 6.3 M hectares in 2003 and accounting now for 3.6% of all cultivated land in Europe. Italy had the most important organic area with more than 1 M ha (about a fifth of EU-25), followed by Germany, Spain and United Kingdom and France. This has been achieved despite organic food production receiving few specific subsidies from the Union's annual €16 billion spending on support to farmers and rural areas, although farmers using organic methods can benefit from a range of financial incentives to make production more environmentally friendly under the so called Agri-Environmental Schemes (see Box 8).

Market performance – There has been considerable growth in the market of organic products in Europe in recent years. ***In 2004, the EU-25 market for organic food products was estimated to represent about €11 billion.*** Germany was the largest national market with a share of about 30% of the total EU market volume. The highest growth rate in the last years has been observed in France and the United Kingdom (with annual average growth by more than 40% over the period 1999-2002). In Italy and the Netherlands the average organic market growth varied between 20-30% per year, in Germany it was about 15%. The share of organic products in total turnover of food production was about 1% on EU-15 average in 2001.[130]

Such is the popularity of organic produce that major food multinationals and retailers have launched their own brands or bought established products to get a share of the growing market (for the purpose of this study, the problematic relationship between retailers and producers is not here explored, though it is important to note that it will require addressing given the sustainability context in which organic farming has developed and falls under).

Cadbury-Sweps bought Green & Black's, Europe's leading organic chocolate brand, and Heinz has recently launched its own range of organic products, as a result of consumers' demand and a strategic decision by European retailers to stock organic goods.[131] The popularity of organic food has run ahead so fast that despite the rapid increases in production used on organic methods, demand has outstripped supply, with imports needed to fill the gap – most of which coming from Asia.

Sector's performance – At EU-25 level, 149.000 holdings are certified organic and in-conversion holdings,[g] which represent 1.4% of total agricultural holdings. In EU-15, certified organic and in-conversion holdings increased from 29.000 in 1993 to more than 140.000 in 2003 and account for about 2% of all holdings. Italy has the largest number of organic holdings (31% of EU-25 total), followed by Austria, Spain and Germany. ***In the EU-25, the average organically cultivated area per holding at 40 ha was significantly larger than the average area of conventional holdings at 15 ha of UAA*** (utilised agricultural area). ***The growth of the organic farming sector is triggering other related sectors to also expand. In 2003, the total number of registered operators (producers, processors and importers of organic produce) in EU-15 was about 157.000, which represent an increase of 30% compared to 1998. The number of registered organic producers alone increased from 100.000 in 1998 to 135.000 in 2003,*** representing about 2% of all agricultural producers. The number of organic processors reached about 25.000 in EU-15 in 2003. ***In 2003, there were about 1400 registered importers of organic products in EU-15, an increase of 160% compared to 1998.*** Germany ranked first with about 35% of the total importers of organic products, followed by Sweden (18%) and Italy (13%).

f Most subsistence farming is organic but it is not certified as such.

g Holding that are moving from conventional farming to organic.

Competitive alternatives to agricultural biotechnology

The following paragraphs illustrate the main social benefits derived from organic farming, whilst Box 9 provides a concrete example of the socio-economic implications of organic farming in the region of Tuscany, Italy, as a successful case of rural development policy:

Employment implications – In 2005 the Soil Association published a survey conducted by the University of Essex in the UK and Ireland on 1144 farms to compare the employment implication between organic and conventional farms. The survey, found that ***organic farms involved in "on-farm processing" and direct marketing enterprises employed 64% more people than organic farms without such activities. With a significant proportion (39%) of organic farms engaged in this type of business innovation, organic farmers are at the vanguard of revitalising local and regional food economies – in line with the objective of rural development and sustainable development of the European Union.***

The devaluation of agricultural jobs in the UK, for instance, has driven 78% of farm workers from the land in the last half a century alone.[132] This has created a vicious circle, with younger people increasingly displaced into the cities, leaving a smaller pool of new, appropriately skilled people in rural areas to fill the positions needed to keep the remaining farms viable.[133] It could be said that this trend is at odds with the more labour intensive approach of organic agriculture but, in fact, the additional job opportunities created by organic farming are helping to address wider employment needs across the European Union. In Germany, Renate Künast, Germany's Consumer Protection Minister, stated in April 2005 that ***organic farming in Germany has created 150,000 jobs.*** To fill the gap, many UK farms, for example, are employing workers from abroad, particularly Eastern Europe. The UK's Home Office statistics show that 36.600 applications (12%) for the Worker Register Scheme between May 2004 and September 2005 were for agricultural jobs.[134] According to the European Commission itself, a substantial increase in hired labour is shown for organic farms in Denmark (between 16 & 38%).[135]

Implications for social cohesion – The intensification of agriculture and the loss of jobs on farms also has devastating consequences for community cohesion. In the 1950s, researcher Walter Goldschmidt compared rural areas, dominated by large corporate farms, with those where smaller family farms prevailed. In towns surrounded by family farms, Goldschmidt identified stronger social fabric, greater community coherence and civic participation. Income circulated among local business establishments, generating jobs and community prosperity. In contrast, there was a general decline in social capital and local employment in communities dominated by large-scale industrial agriculture. Studies updating Goldschmidt's original work in the 1970s, 1988 and most recently in 1996, confirm that his findings remain true today. Similar negative trends are apparent in the UK, as a diverse network of mixed, smaller farms is displaced by fewer, larger commodity producers. As a result, many rural areas no longer have the population densities to support local services. For example, 4 out of 10 parishes in rural England have no shop or post office, six out of ten have no primary school and three-quarters lack a bus service or health clinic.[136] As the previous section on employment implications of organic farming illustrated, ***organic farming, especially there where the processing and retailing on the produce is managed directly on the farm, is helping to strengthen the social cohesion of rural communities.***

Implications for environmental protection – Although this report has limited itself to explore the socio-economic implication of the agricultural activities, it is imperative to mention, with reference to organic agriculture, the important environmental benefits of this practice. The main environmental benefits of organic production are on biodiversity and soil structure. Also water quality is improved in cases where the sustainable organic fertiliser rules result in a significantly reduced N-balance. Analysis from Germany shows that organic farms have lower input and concentration of nutrients compared with usual practice, which leads to reduced leaching into water, and reduced emissions to the atmosphere. The limited use of pesticides, broad rotations, and increased input of organic matter inherent in organic farming contribute to the protection and preservation of species. There are, however, limits, because the complete protection of biodiversity alone through organic farming is not possible. Additional environmental measures like the establishment of biotope areas and structural features are also important for the protection of the diversity of fauna.[137] ***A recent study by the Cornell University published in Bioscience illustrated the findings of a 22-year-long trial comparing organic with conventional farming in the US. Whilst yields were found to be comparable, organic farming used 30% less energy, less water and no pesticides.***[138]

box 8: Socio-economic implications of organic farming and rural development policy in Tuscany

The Tuscany region has recently released an evaluation of its rural development plan (PSR) 2000-2006. The assessment found that of the 5214 grants allocated by December 2004, 56% of beneficiaries were young farmers (below 40 years of age), almost 35% of which women and 12% being organic farmers. Within the organic sector, accounting for 55% of the total area financed by the PSR, about 39% were young farmers. This is an encouraging figure for the region, since in conventional farming, young and women farmers represent only 9% and 28% respectively of the workforce. In the 2000-2006 RDP, ***investment measures attracted an average of 23% more value per investment in organic farms than in conventional farms and product value increased when proven organic, a trend that is in the increase in the region.*** It was also noticed that, contrarily to conventional farming, organic produce is typically sold directly from the producer to either the consumer or the processing industry, hence allowing for the added value of the product to remain within the farm, as opposed to going to middle-men. This has impacted positively on the processing industry, which has now grown by 25% over the 2000-6 period. Overall, the assessment concluded that ***organic farming improved the rural community by attracting young farmers, women and investment.***

2.3.2. The challenges ahead for organic farming

Global sales of organic food & drink are soaring, however supply-related problems are expected to increase as production becomes international. The European organic food industry is also experiencing supply shortages. Most sales of organic foods are from countries where consumers have high disposable incomes. The G8 countries account for over 80% of total sales, whereas their share of international organic farmland is a mere 12%. A growing number of European supermarkets are offering fixed contracts to livestock farmers to encourage them to convert to organic practices. Product shortages in North America and Europe are resulting in organic food imports from across the globe. Organic ingredients like beans, seeds and nuts are increasingly coming from countries like China, Turkey and Brazil. Organic herbs & spices are being imported from India, Paraguay and Ethiopia. Increasing volumes of organic fresh fruit & vegetables are coming in from African and Asian countries. Latin America and Australasia are already established sources of organic meat products.

Organic food production has indeed become global, however the disparity between producer and consumer countries is growing. Demand for organic products is concentrated in affluent countries where production of organic foods is increasing at a relatively slow rate. The largest increases in organic food production are in developing countries, which have very small internal markets for organic products. For instance, the amount of organic farmland in Africa, Asia and Latin America has reported triple-digit growth since 2000 compared to double-digit growth in other regions. However, production in these regions is highly export-geared with relatively few certified organic products sold in producer countries. Therefore, if supply of organic foods has become global, demand has not. The challenge is creating demand in countries where large sections of the population cannot afford to pay the price premium for organic foods.[139]

There is a need therefore to research a solution to these issues, however, as Box 10 illustrates, R&D in the field of organic farming is still far from competing with R&D in agricultural biotechnology.

box 9: Organic farming research in Europe[140]

Organic farming R&D is organised differently across Europe.

Until the 1980s it was mainly carried out by private research institutes, which have been the driving force for the development of organic farming research since the 1920s. In the 1980s the first universities took organic farming on their curricula. In the 1990s the first EU-funded projects on organic farming contributed to a better collaboration of researchers on organic farming on a European level, and the first state research institutes became active.

Today's high political and societal acceptance and interest in organic farming research is reflected in the fact that many national research institutions include special programs for organic farming research. For instance, in Germany, the Federal Organic Farming Scheme (BOEL) has a dedicated research department and, in Denmark, the Danish Research Center for Organic Farming (DARCOF) has been running since 1996.

At the state research institutions organic farming is getting increasing attention in many countries, for instance, in France, the National Agricultural Research Institute (INRA) now has an organic farming co-ordination group (Comité Interne Agriculture Biologique, CIAB). The German Federal Agricultural Research Institute FAL has one research institute dedicated to organic farming research. The ERA Net project, CORE Organic, funded by the European Commission, has promoted the cooperation among funders of research programmes via the use of Organic Eprints archive to document organic farming research in Europe. In recent years this archive has developed as a major tool for communication about organic farming in Europe, and it holds more than 5000 entries.

At the international level, cooperation in organic farming research takes place in the framework of the International Society of Organic Farming Research, ISOFAR.

The EU group of the International Federation of Organic Agriculture Movements, IFOAM, has made a number of suggestions for areas to be funded under the 7th framework Programme of the European commission, including the establishing of a technology platform on organic agriculture, similarly to those already existent on agricultural biotechnology.[141] However, this request has been refused by the Commission's DG Research. As stated by director of the UK Soil Association Speaking at a conference on organic food in 2001, *"[u]nless there is education into organics, much of the potential wider benefits for society and the development of local economies will be lost. It would be a tragedy."*[142]

Conclusions and Recommendations

3

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"The debate must, however, remain science-based, and we must take a balanced view on matters of concern, such as GMOs, and avoid taking extreme positions. Clarity and knowledge will help to lower emotional prejudices."[143]

Günter Verheugen
Vice President of the European Commission

The study has provided a brief comparative assessment of the socio-economic implications of agricultural biotechnology and agri-environmental farming, including organic agriculture and has based its analysis on scientific data provided by the European Commission, academia and the biotech industry itself.

Bearing in mind that the assessment was carried out with reference to the EU's wider policy objectives of competitiveness and sustainable development, the study concludes that ***genetically modified food and crops does not constitute a strategy for fostering Europe's competitiveness,*** for, in a nutshell, it is failing to create jobs, improve the performance of the industry, grow economically, attract investment and deliver safe and reliable products.

In contrast, ***according to the findings of this study, the organic agricultural sector has created more jobs, contributed to a younger farming population and stimulated rural economies, in line with Europe's commitments made in Lisbon and Stockholm on competitiveness, economic growth, job creation and rural/sustainable development.***[144]

Agri-environmental farming, and organic agriculture in particular, appear to provide a much sounder strategy for Europe, in terms of Europe's commitments to job creation, economic growth, social cohesion and sustainable development. With demand in organic food products on the increase across Europe, the EU needs to ensure that its domestic organic food supply meets its consumers' demand. Ensuring a harmonised regulatory framework for organic food production and investing in organic farming.

These external benefits to environmental farming practices raise important policy questions. In particular, whether farmers should receive public support for the multiple public benefits they produce? Should those that pollute (through GM contamination) have to pay for restoring the environment and human health? The possible co-existence of GM and non-GM farming in Europe raises a number of pressing issues.

As the Commission has recommended itself, technical assistance should be used to build European and national networks for rural development, as a platform for exchange of best practice and expertise on all aspects of policy design, management and implementation between stakeholders.[145] A number of initiatives exist and are taking place and need to be encouraged further. EU Research funds should be focussing on projects aimed at fostering and improving rural development, as opposed to subsidising a failing industry that will jeopardise, as opposed to strengthen, the EU's overall goals of economic growth and job creation.

Lettuce growing on an organic farm in the Netherlands.

Organically grown corn in Lesotho.

Conclusions and Recommendations

	Food Biotechnology	Agri-environment measures and organic farming
Industry competitiveness	> Agribiotech business revenues in the EU are on the decline, public offerings are irrelevant, venture capital investment is minimal, and companies are relocating abroad or shifting to more profitable areas, such as therapeutics. > Both in the EU and in the US, agribiotech companies received less than 1% of the venture capital with the lion's share going to human healthcare and diagnostics.	> Agri-environmental measures show increased profitability for farmers compared to conventional farming > Demand for organic products is growing at double digit rates in many EU countries and outstripping supply > Amount of organic farmland in Africa, Asia and Latin America showing triple digit growth since 2000 > Major food companies have launched or acquired organic brands
Market diversity and innovation	> Acquisitions and mergers have led to just six corporations (Monsanto, DuPont, Bayer CropScience, Syngeta BASF and Dow) dominating GM crop and seed production. This is squeezing out competitors, neglecting smaller markets and decreasing knowledge production.	> Rapid increase in organic holdings in the EU is being accompanied by similar growth in organic processors and importers > Organic farms, especially those where processing and retailing is managed on the farm, are showing quantifiable increased social cohesion of rural communities and stimulation of local economies.
Impact of products	> Only two GM traits have been used on any significant commercial scale. This includes the US where 70 distinct GMO 'events' have been authorized for commercial growing. > Problems are emerging such as increased tolerance to the GM-crops' herbicides, requiring increased levels of chemical applications. > There have been considerable costs to both the GM and the non-GM food chain associated with GM contamination. The European Commission considers GMO contamination a serious problem. In the US, GM rice contamination has caused the rice market to plummet and US farmers suing the biotech producer, Bayer, for loss of market.	> Research shows that organic production - has comparable yields to conventional farming -uses 30% less energy -uses less water -uses virtually no pesticides
Job creation	> There are only 96 500 jobs in biotechnology in Europe of which 80% are in the health sector. > Lack of a profitable market has caused the industry to reorganise its workforce. Cuts have been made in order to meet overall profit targets. The result has been a loss of thousands of jobs in Europe over just a few years.	> Figures from the European Commission and university research indicate that agri-environmental initiatives, including organic farming show job creation including amongst young people. > The organic market is growing: the EU public and more affluent markets in general are showing increased demand for organic produce which is outstripping supply.
GM crops: 25 years of EU research, only two traits	A conservative figure for spending on GMO food research is 400 million euro for the period 1982-2007 with an average of 80 million euro per year (excluding applications like biofuels and pharma crops). This does not take funding by individual member states into account which was for example 47 million euro and 61 million euro for the UK and Germany in 2001 alone. > There is no evidence of revolutionary developments in the foreseeable future – technical and market constraints restrict progress. The European Commission however funds a Technology Platform on plant biotech which is calling for 45 billion euro for agricultural biotechnology by 2015 *"if Europe is to remain competitive."*	Initially funded only through private research institutes, public funding for agri-environmental initiatives has increased in recent years although it remains marginalized. The European Environment Agency recently called for more funding into such initiatives. However, the European Commission's DG research has refused to fund a Technology Platform on organics, and the recently adopted EU Framework Programme 7, worth 50 billion euro, has selected biotechnology in food and agriculture as as a key thematic area.

3

In September 2005, during the presentation of "The Commission's new Biotech Policy", EU Commissioner Verheugen stated that *"Europe has to make up its mind whether it wants to use the full potential of green biotech to become competitive [...]."*[146] As the most recent Eurobarometer reported, European citizens have already made their mind up, for 58% of European consumers do not want GM foods and people in Europe generally believe that food biotechnology should not be encouraged.[147]

With the EU Biotech Strategy up for review, Members of the European Parliament and EU Member States will have to give, in the upcoming months, serious consideration as to whether public and private investment should be encouraged further towards the development of a biotech sector in Europe. From the analysis undertaken in this study it is clear that the current focus on biotechnology will not represent a successful strategy for Europe and will not lead, in any way, to furthering the objectives set in Lisbon, nor will it help Europe meet its commitments to sustainable development and policy coherence.

The Mid-Term Review must ensure that its assessment is based on solid and sound data, and not on Commissioner Verheugen's "emotional" enthusiasm for an industry that has failed, so far, to deliver.

3.1. Recommendations:

1. Mid Term Review of the EU Biotech Strategy should include failure of GM food and crops

- The revised EU Biotech Strategy should ***segment the different biotechnology sectors (green, white, red)*** and assess each one according to its strengths and weaknesses. This should also be done in other policy and legislative processes.
- Member States and the Commission should work together to ensure biotechnology ***sector-specific data***
- The Mid Term Review should take ***current market reality*** into account when deciding actions for food biotechnology. The views of EU citizens, policies of major retailers, and the right to GMfree food and farming must be unconditionally respected. On public opinion, the revised strategy must acknowledge that EU citizens have now been consistently opposed to genetically modified food and crops for ten years.
- Based on the evidence from research, including government and industry figures, the revised EU biotech strategy ***must acknowledge the failure of genetically modified food and crops and therefore exclude this sector when fixing new targets***
- The European Commission should carry out a ***policy-specific audit*** of EU agri biotechnology policies and research funding

2. EU research priorities and funding should focus on agri-environmental sectors

- The EU's framework programme 7 (FP7) should ***de-prioritise its theme on biotechnology and food.***
- ***Future research priorities,*** including under FP7, on competitive agriculture and food sectors should increase focus on the potential, and challenges, shown by **agri-environmental sectors,** including organic farming.
- ***Greater priority should be given to DG Research "Science in society" initiatives***
- ***A Technology Platform*** on organic farming should be funded by the European Commission
- EU funding under FP7 should be made available to develop an ***EU research project on the socio-economic impacts of agri-environmental farming in EU member states.*** Such a study should include stakeholder participation from the very beginning of the study and should be carried out by an independent body, such as the European Environment Agency.

3. Increased political support for agri-environmental measures, and indicators in all policies to ensure all Lisbon agenda goals are met

- ***Binding commitments and increased funding*** for the Common Agricultural Policy (CAP) Pillar 2 must be adopted and implemented by all Member States, when the CAP is reformed in 2008, as agreed in 2003, and as proposed by the European Commission for the Financial Perspectives 2007-2013.
- ***Quantifiable commitments*** to achieving the socio economic and environmental goals of the Lisbon Agenda must be made in EU Industry Policy
- Members of all Commission ***Advisory Groups*** covering food and agriculture must be made public

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A field of Barley.

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