

Why are most Europeans opposed to GMOs? Factors explaining rejection in France and Europe

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Acronyms and abbreviations: ATTAC: Association for the Taxation of Financial Transactions for the Aid of Citizens; BSE: Bovine Spongiform Encephalopathy; DNK/DK: Don't know (in a survey); EC: European Commission; EU: European Union; EU 15: The 15 Member States of the European Union in 2001: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Portugal, Spain, Sweden, the Netherlands, United Kingdom; Germany (new Länder): former East Germany - Germany (former Länder): former West Germany; GM: Genetically Modified; IFIC: International Food Information Council Foundation (USA); IFOP: Institut français de l'opinion publique (French Institute of Public Opinion, a market research and opinion surveys Institute); IPSOS: A polling institute; LETS: Local Exchange trading Systems; NGO: Non Governmental Organization.

A strong movement of opposition to GMOs developed in the late 1990s in many countries, especially in Europe, although these technologies were presented from the outset as highly promising and their advantages were often highlighted. How can this rejection be explained? The aim of this paper is to answer that question through the case of France, which is fairly representative in this respect of various European countries, even if the opposition movement is here particularly strong. One examines various factors, actors and processes that have led to such strong opposition to GMOs that at this stage their development in Europe has almost totally been halted. In the first part of the article we recall the results of several recent surveys, showing the level of acceptance or refusal of genetic engineering in several countries. We then examine important factors of rejection: the focus on potential risks of GMOs and the extensive publicity given to them, coupled with the inadequacy of answers to these diverse criticisms, and a drawing up of an unfavorable risk-benefit balance. Lastly, we point out that various fears and objections to the evolution of agriculture and to the functioning of society (*i.e.* limited trust in institutions and firms) appear to be crystallized around GMOs.

are still considered by many to be highly promising? The aim of this article is to present various factors and processes in the emergence and explanation of this opposition in France, a country in which it is particularly strong. We look at the French case which is fairly representative in this respect of various European countries; even if differences exist, depending on cultural characteristics and economic situations, a number of factors of opposition are found throughout.

A great number of papers have already been published on opinions and attitudes toward GMOs in the EU. Because of this extensive literature, a global review is not presented here. These papers on the public perception of GMOs deal mainly with typologies or segmentations of consumer attitudes and with more static analyses of public perception of biotechnology as well as with agenda-setting, decision-making and regulation of this issue. Our approach is a little different and tackles more the factors of development and strengthening of GMO opposition in the general public. Such analysis seems especially important in view of the current deadlock. It seems useful to get a better understanding of this opposition movement, its determinants, its grounds and its implications, especially since it is sometimes misinterpreted. The results presented here are based on an analysis of the factors and mechanisms of the development of the opposition movement. We examined recurring topics in public and private discussions and debates on this subject, in the discourse of opponents and in articles on GMOs in the media where we looked at a great number of different articles in newspapers, magazines, radio and TV programs. Furthermore we monitored and observed initiatives by the various actors. As regards quantitative data, we drew on the results of a set of surveys, particularly the Eurobarometer surveys (organized and supervised by European Commission), which have

A strong movement of opposition to the agricultural applications of genetic engineering has developed throughout the world, particularly in some countries such as in the European Union. It has led to a moratorium in the EU – no transgenic crops are cultivated in the EU since 1999, except some Bt corn in Spain – and to hostility towards the importation of GM products, as well as to acts of open opposition. How can this strong hostility be explained when biotechnology, including genetic engineering, has generally been presented from the outset in a highly positive light and

been carried out several times in the 15 EU countries, on a sample of approximately 16,000 people. Several Eurobarometer surveys were devoted to attitudes and opinions on biotechnology and provide interesting results on this topic.

Strong opposition to GMOs in Europe and particularly in France

In the first place it seems useful to present the results of some detailed public opinion surveys on GMOs. Here the results of such surveys in the USA and in the countries of the EU are set out because they are often considered to have quite opposite views on this issue. In developing countries --as in developed countries-- expressed opinions about GMOs seem to vary from country to country and from social group to social group. For example they appear relatively more favourable in China; and in many countries views are influenced by gender, income level, age and socio-professional status (Ipsos-Reid, 2002). The main decisive reasons for opposition vary as well. In this way, some countries such as Brazil seemed to avoid GM crops more to protect their exports than due to prevailing strong opposition. However, it is not possible to present the results of such surveys for many countries throughout the world. Because of differences in the survey dates, the question formulations, the contexts and the possible specificities of the responding samples (if they are not representative of whole populations), their comparison could be hazardous and lead to too hasty deductions.

Indeed, survey results have to be interpreted with caution in particular by decision-makers, for they have various limits. These limits are above all: (i) the risk of artifacts when the respondent has to choose, in a short space of time and out of context, an answer in a series of items proposed on a complex subject; (ii) the possible effect of the formulation of the questions and their interaction on the answers obtained; (iii) the influence of the context and of recent events; (iv) lastly, the risk of superficiality of the approach compared to more in-depth interviews. But compared to the latter, opinion polls have the advantage of providing indicators on vast samples representing the group under study. The limits explain the variations of results between some polls carried out in the same country (ABE, 2002). In addition, a stated opinion may differ from an effective opinion, and from a behavior in a real situation where other factors play a part. In spite of all, polls prove to be a useful source of information, to be used with other methods. Bearing these limits in mind, we hereafter present the data of some of them carried out in the EU to have an insight on the degree of opposition and on its variations; before that, several results of polls in the USA are set out. For the EU and the USA, we have chosen recent polls because the opposition movement intensified after 1998; prior to that, opinions were on the whole more favorable (Hoban, 1997).

In the USA. The IFIC (International Food Information Council) commissioned surveys on a sample of about 1,000 people in 1997, 1999, 2000, 2001 and 2002 (IFIC, 2002). It enables a follow up of opinion several years in a row because the same questions were asked several years in a row. Various questions on attitudes toward food biotechnology were formulated by referring mainly to its advantages. Therefore the survey results can be used more as regards the trends than in absolute value compared to others which have more neutral formulation. For example some polls ask more neutral questions like "Suppose you are food shopping in the grocery store and the food you are considering purchasing is GM or contains GM ingredients. Knowing that particular food product contains GM ingredients, would this make you (a) much more likely (b) somewhat more likely (c) somewhat less likely (d) much less likely to buy the product, or (e) would it make no difference to your purchase choice?" (Angus Reid Group, 2000a; Angus Reid Group, 2000b). With the examples of genetic modification proposed in the IFIC questionnaire, propensity to buy GM foods was shown to be far greater than reticence, but declined a little between 1997 and 2002 (Table 1). The feeling that biotechnology will be beneficial also diminished between 1997 and 2000, particularly in 1999, but tends to be quite stable later (Table 2). Note that the reduction in pesticide applications is considered more positively than an improvement in taste owing to genetic transformation. Some other surveys show a little less positive attitude toward GM food by American consumers (Angus Reid Group, 2000a; Angus Reid Group, 2000b; Pew, 2002). However, the attitudes in the USA are usually more favorable than those in other countries, particularly in European countries.

In the European Union, Eurobarometer surveys reveal growing skepticism as regards biotechnology. The most recent Eurobarometer survey on this topic was carried out in spring 2001 on about 16,000 people in the EU^[1]. It enables a comparison between the different EU countries because the same questionnaire has been used in the 15 EU countries. The questionnaire, filled in during face-to-face interviews, addressed various issues related to technological and scientific progress^[2]. Among them, some questions polled Europeans on biotechnology. Previously, in the nineties, other Eurobarometer surveys were specifically devoted to biotechnology and tackled many aspects of opinion about it (Eurobarometer, 2000; Gaskell et al. 2000). From the 2001 Eurobarometer some specific results dealing with GMOs are presented here. They show a high level of mistrust of GMOs (Table 3). "The most commonly encountered attitude is the demand to be able to choose and the demand for information: 95% of Europeans want to have the right to choose when it comes to genetically modified foods. There are no exceptions to this demand which consistently scores the highest within all the various subgroups making up the sample. Secondly, people

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want information: 86% of those asked wanted “to know more about this type of food before eating it” (Eurobarometer, 2001).

Outright rejection (“I do not want this kind of food”) is the attitude of 70.9% (Figure 1). Although this attitude is very widespread in Europe, it is nevertheless subject to certain variations (Eurobarometer, 2001). Variations according to usual socio-demographic criteria (gender, age, education level, profession, income, etc.) appear smaller than variations between countries. If 71% of Europeans say they do not want this kind of food, there is a noticeable diversity in the EU. As Figure 1 shows, a few countries (Greece, France, Austria and Luxembourg) appear particularly hostile to GMOs, some others (Netherlands, UK, Belgium, Denmark) appear more favorable or less hostile.

The socio-demographic analysis shows the lowest level of rejection among students, youth, higher income people and men: more than 20% disagree with the statement “I do not want this type of food” (and less than 67% agree). On the opposite, house-persons, lower income people, the elderly and women agree at a proportion above 74% with “I do not want this type of food”. In particular, students and young people are the least hostile to GMOs: 63% of students and 64% of the youngest members of the population (15-24 years) adopt this attitude of rejection as opposed to 75% of the eldest (65 years and over). This slightly less hostile attitude on the part of young people is not related to a higher level of knowledge (this attitude holds good among the youngest whatever their level of knowledge.). But it is confined to young men: among the 15-24 year olds, 60.7% of men are hostile to GMOs as opposed to 68.1% of women. Two hypotheses are possible to interpret this difference related to age (Eurobarometer, 2001):

- either this is a specific feature of generations, which would imply that young people have become accustomed since their childhood to the scientific innovation symbolised by GMOs and are therefore less hostile; in that case, these age groups would retain their specific character as they get older, the generations following would do more and more the same and the fear of GMOs would tend to dwindle in society;
- or this is an age group phenomenon: the youngest, precisely because they are young, are less likely to perceive GMOs as a possible hazard, but this attitude will tend to disappear as they grow older. In that case, the difference in attitudes between the young and the less young would not imply an overall change in society’s attitude to GMOs in the long term. For the moment there it is not possible to choose between these two hypotheses; both of them can play in fact; so further surveys on this

topic are necessary in the future (Eurobarometer, 2001).

As to whether “GMO-based food is dangerous”, a majority (56.4%) believe that this proposition is true, as opposed to 17.1% who don’t; however this is an open question for more than a quarter of Europeans (26.5% of “don’t know”) (Table 3). As for the previous question about the level of rejection of GM food, variations per socio-demographic characteristics are smaller than those per country. The feeling of danger is a little lower among managers, students, high income people, educated people (*i.e.* those who have studied beyond age 20) and men: among them, less the 54% think that it is true that “food based on GMOs is dangerous”. On the opposite, among self employed, house-persons, rural area or village inhabitants and women, more than 58.7% are worried and the feeling of danger is higher. Thus, people who are a little more vulnerable or fragile appear to be a little more worried about the potential risks of GMOs.

However, variations by country are higher (Figure 2): in the Netherlands, Finland, the UK, Sweden less than 46.5% of people think that is true that “food based on GMOs is dangerous”. On the opposite, in Luxembourg, France and Greece, more than two thirds of the inhabitants believe the same. This greater level of variation by country than by usual socio-demographic variables can be linked to the importance of cultural aspects, as well as to the differences in the public debate, government intervention, history of economic development and industrial situation between the various European countries (Zechendorf, 1998; de Cheveigné et al. 2002; Springer et al. 2002).

The focus on potential risks and the extensive publicity given to risks

In the case of France, what factors explain this increasing hostility in public opinion? While in many technical fields numerous process innovations are hardly noticed or are known only in limited circles, the controversy on transgenic plants drew a wide audience and received extensive publicity, especially in the late 1990s. As the intensity of the GMO debate heightened, opinions became increasingly radical.

Many risks or negative effects are suspected in a very wide field. We have established a typology of these risks, fears and reasons for refusal, on the basis of the subjects mentioned repeatedly in public or private debates, articles and arguments against GMOs (Table 4). This focus on the risks of a technical innovation is nothing new. At the time of their introduction many innovations were violently opposed, *i.e.* industrial mechanization, the railway, the potato, etc. (Salomon, 1984). But in the case of GMOs this opposition has been particularly strong and widespread. So

in Europe GMOs have comparatively few advocates or supporters.

How has this negative view emerged and grown?

Despite parliamentary debates in 1992 at the time of the transposition of European directives concerning the dissemination of GMOs, and various articles in the media on biotechnology, discussion on the subject remained limited in the early nineties to a fairly small circle. It started to spread in the public at large mainly from late 1996 when the very first imports of transgenic seeds from the USA arrived in Europe and animated debate surrounded authorization of Bt corn from the firm Novartis. At that stage, public opinion was strongly marked by various affairs, especially contaminated blood (HIV), mad cow's disease, asbestos^[3]. They led to strong distrust and caused people to think that firms and public authorities sometimes disregard certain health risks in order to protect certain economic or political interests (Joly and Lemarié, 1998; Vogel, 2003). At the end of the 90's, debate on GMOs (authorization, importation, labelling, impact, etc.) was situated in a context strongly influenced by food safety issues (BSE, listeriosis, etc.) that had been widely publicized. Furthermore, the movement criticizing the various excesses of the agricultural and food system, that had previously been a fairly minority affair, grew as problems of pollution and safety came to the forefront. Now, GMOs were perceived as a strengthening of the highly industrialized agriculture that is precisely a target of much criticism in western Europe today, particularly in France (Bonny, 2000a). An increasing number of articles were devoted to technological risks.

Thus, at the time when GMO issues were widely publicized from late 1996, the confidence in institutions and in certain technological advances had decreased. A great and growing attention was so paid to the warnings of various associations and to the denunciation campaign run by them against genetic engineering. The media and the general social debate took a fairly critical view. Thus information spread and received on GMOs has been and is frequently critical or even negative.

The strong influence of associations that focus on risks. In France GMOs have been strongly opposed by various NGOs, groups and associations. Initially these consisted essentially of ecologist organizations (Greenpeace, Friends of the Earth, etc.) and groups of various tendencies (*i.e.* Ecoropa, the Natural Law Party), as well as supporters of the Green political parties and organic agriculture associations. This movement progressively expanded from environmentalist circles towards groups active in the economic domain including, for example a farmer's union –the Confédération Paysanne–, anti-globalisation organizations (ATTAC), LETS, etc. Finally, small circles of associations were created for the very

purpose of fighting against GMOs. The impact of these associations has been strong, owing to the dynamism of their action which gave them extensively publicity: numerous strongly-worded press communiqués, the repeated mass dissemination of alerts and warnings, petitions, leaflets, standard letters to send to elected representatives or agro-food firms, lawsuits, demonstrations, and so on. In particular, these groups took advantage of the new communication technologies: multi-transmission of information via automatic mailing lists, electronic forums, extremely well documented web sites used extensively by many as sources of information, etc. The endless reuse and circulation of certain information (sometimes very partial or biased) on the internet gave it credibility due to multiple repetition that ended up making it seem reliable (since it was frequently mentioned, it was corroborated). Moreover, the influence of groups that had taken a stand against GM extended way beyond their own supporters to many sympathizers or people close to them, particularly to people with some left or ecologist leanings.

The mobilization of the staff and members of many associations on this issue was intense, not only because they felt strongly about it but also because it helped to establish their audiences and legitimacy, especially in the case of diverse associations that were formerly in a tiny minority. For example, its anti-GMO action was instrumental in bailing out and strengthening Greenpeace-France which had been in serious financial straits and was experiencing a relative drop in its membership compared to other North European countries. Greenpeace now has sound legitimacy and is invited to many debates and conferences. More generally, the GMO issue has enabled various groups or associations to enhance their renown, recognition and resources, and to acquire a degree of legitimacy by presenting themselves as defenders of consumers and of their health and interests, but also of the environment and of the interests of developing countries or of future generations. Since it has proved to be so fruitful, this encourages them to pursue their militancy in this field and to devote more resources to it. In contrast, the strong controversy on genetic engineering led to an increasing questioning towards certain fields of scientific research.

Of course, many actors other than associations are involved more or less directly in the GMO field, but their respective influence varies widely. For the entire EU, the Eurobarometer survey in late 1999 showed that the actors who were judged most often by respondents as "doing a good job for society" as regards GMOs were primarily consumers' unions, doctors, then the media and environmentalist groups. By contrast, industry is the only actor judged most often as not doing "a good job" for society in this respect. So, in 1999 38% of the European (and 51% of the French) tended to disagree with the sentence: "do you think that industry developing new

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products with biotech is doing a good job for society?" while 30% of the European (and 25% of the French) tended to agree (Eurobarometer, 2000). Industry seems so to have little credit and its arguments are therefore taken into consideration relatively little or are even discredited. By contrast, other actors that are often opposed to GMOs – consumer unions, environmentalist associations and the media – have more legitimacy and are therefore taken into account and quoted more often. This sheds light on certain determinants of opposition to GMOs and on the respective impact of the actors involved.

Behaviour of other actors involved in publicizing information on risks. The publicity given to various associations' denunciation of GMOs has been noteworthy, particularly in the case of the media. The latter have played a significant part in making GMOs widely known and in highlighting their potential dangers, especially at the end of the nineties when many journalists became increasingly opposed to GMOs, and at the beginning of the 2000s with their growing rejection. From 1997-1998 onwards and more and more thereafter, the media frequently took up and spread a number of opponents' arguments, at least in part. Whereas previously – especially in the early 1980s when there were few articles on the subject – the media presented biotechnology as a promising innovation, in 1999 and 2000 increasingly critical opinions were often expressed. A number of journalists focused on risks and expressed standpoints opposed to GMOs, sometimes entering into opposition movements themselves (Durant and Lindsey, 2000; Kassardjian, 2002). This can be explained by various factors. Initially, the subject of biotechnology was treated by scientific journalists who were relatively in favour of it. Later, when the topic became more politico-economic, it was also covered by other journalists, for example those who had worked on the issues of "contaminated blood", asbestos, BSE, etc., and who drew parallels between these issues. Another explanation lies in the characteristics of the journalistic profession and the increasing strong competition within the media sector (Champagne, 2001). Shocking headlines revealing hidden dangers and dramatic presentation of issues guarantee wider audiences and have more impact than more moderate, qualified articles; hence, this tendency to overstate and outmatch one another. In addition, at this period, issues of technological risks and their prevention and management became a frequent topic of debate, especially in agricultural and food sector.

Furthermore, the communication methods of associations opposed to GMOs often guaranteed them a strong impact in the media. These associations focused on spectacular actions announced in advance. Pictures of activists chained to or climbing onto strategic or symbolic places, photos of large protest banners, destruction of transgenic crops, and so on, had every chance of receiving extensive media coverage due to their characteristics and attractiveness. This

is precisely one of the aims of this type of action (Ruckus Society, no date). Likewise, their press communiqués were particularly lively, stimulating and clear, and their web sites well documented.

On the other hand the firms involved have often maintained a more traditional type of communication, strongly influenced by their usual clientele – the upstream Agricultural sector, not the public at large. Moreover, until 1997-98 they often underestimated suspicion of GMOs, considering it to be the product of irrational and somewhat residual fears that would progressively disappear as more information became available. But their promotion of the advantages of GMOs did not convince the public.

As for the public research organizations, on the whole they did relatively little public relations work on the subject in France, especially compared to the associations involved. Institutional communication often remained focused on the presentation of important results obtained by research teams. No statements were issued to clarify the matter when facts or controversies on specific points concerning GMOs were mentioned in the media (which was very often). As a result, explanations and interpretations disseminated very widely among the general public fairly often reflected the viewpoints of associations opposed to GMOs. Of course, researchers from public research organizations were interviewed, but they were rather frequently too selectively (or too partially) quoted. In addition, the assessments expressed by scientists tend to be complex while those expressed by opponents are very loud and clear: "GMOs are dangerous, we must ban them". We note that the views of researchers in the life sciences on genetic engineering vary, depending essentially on their specific discipline: agriculture and life sciences include many disciplines from microbiology to economics, from plant breeding to soil sciences, from ecology to food technology, etc. In addition, assessments depend on the precise topic considered: a number of scientists are concerned about patents or some economic aspects, not about the process of genetic engineering in itself. So the majority of scientists working in molecular biology and plant breeding "believe that recombinant DNA techniques constitute powerful and safe means for the modification of organisms and can contribute substantially in enhancing quality of life by improving agriculture, health care, and the environment. (...) We (...) express our support for the use of recombinant DNA as a potent tool for the achievement of a productive and sustainable agricultural system" (AgBioWorld, 2002). However, in Europe, particularly in France, scientists were publicly little heard on GMOs. Evaluation methods in public research organizations urge them to publish in highly specialized scientific journals far more than in magazines for the general public or popularised science magazines, and to participate in scientific conferences rather than in debates with the general public. In fact the latter forms of

publicizing results are even frequently discredited in the scientific world. Even if researchers have participated in public debates, in total these have reached only a very small audience. Thus, on the whole, in the public arena, little but silence can be heard from public research.

Conversely, assessments against genetic engineering published or voiced by certain scientists –or people regarded as scientists – quite often get great coverage. "People regarded as scientists" refer to relatively known persons that the media and the general public consider as quite famous scientists while they are either ex-scientists, or engaged activists with scientific background, or specialists expressing themselves outside their field of knowledge, by whom the scientific community recognizes often little of competence on the field of public expression. However, these scientists are frequently enough judged as saying aloud what others dare only to think (for fear of losing their contracts with private firms). French public research has, moreover, published relatively few books or statements for the general public on GMOs (unlike the USA where several scientists' associations released supporting statements). French public researchers have participated in many fairly specialized scientific conferences on this theme, but these have received little attention outside scientific circles. By contrast, the book "Tais-toi et mange. L'agriculteur, le scientifique et le consommateur"^[4] (Paillotin and Rousset, 1999), written by the president of INRA, was judged simply on the basis of its title as legitimising reservations.

However, in December 2002, the French Academy of Medicine (2002) (with the Academy of Pharmacy) and the Academy of Sciences (2002) published reports which backed the use of GMOs. The first report called for the end of the moratorium saying that "no particular health problem has been detected" in the countries where GMOs had been grown and eaten for several years. The report from Academy of Sciences cautiously backed the use of GMOs: the technology should be introduced on "a case-by-case, prudent and reasoned" basis. Even if the reports by the Academies of Medicine and Sciences are quite favourable to GMOs, it is uncertain that they could induce a change in opinion in the general public. Indeed, shortly after the publication of these reports, the organizations opposed to GMOs released communiqués criticizing the reports. They said that the academies are influenced by lobbies and were going out of their scientific competence, and that other scientific bodies had recently been much more cautious. Therefore, the Academies reports are likely to influence only a small percentage of the French population. Among the explanations lies the lack of trust linked to BSE, contaminated blood, etc. affairs. Other people are likely to remain quite opposed to GMOs, and perhaps become a little more opposed if they think that there are economic pressures for ending the ban in spite of environmental or

health uncertainties – as it was highlighted by several organizations. Actually, at the release of the reports by the Academies, the French Ecology Minister said she could envisage the ban being lifted in about a year (for the end of 2003): "We must not go too fast, precautions need to be taken". The French government will not back a lifting of the ban until the new EU labelling and traceability laws are implemented in France – probably at the end of 2003^[5]. The French Research Minister pointed out that the EU was coming under increasing economic pressure to keep up with the worldwide development of GM crops. She said the report from the Academy of Medicine was on the whole very reassuring about the safety of GMOs, but she did not join in calling for an end to the ban. "This encouraging inventory does not exonerate us from the need for great caution and more effort on future research".

Various consumers' unions also became strongly involved in the GMO controversy, without being opposed from the outset. They stressed the need to take into consideration risks and the principle of precaution. In late 2000, delegates at the International Consumers' Organization conference in Durban called for a moratorium: "governments and international institutions should require full pre-market evaluation and social and safety impact assessments of GM foods and the products of other new food technologies to ensure that they are safe, environmentally sustainable and acceptable to consumers, and impose a moratorium on the cultivation and marketing of new GM foods until this is done" (Consumers International, 2000). In the EU the European Consumers' Organization (BEUC) emphasizes that the recent years have shown that GM food will never be accepted without consumer choice. A press release from July 2002 entitled "GMOs or No GMOs: the choice should be ours!" reminds its demand "to ensure that the key consumer rights to information and choice are met" and claims "only clear labelling will ensure that consumers can choose whether or not to buy GM foods".

The question of labelling of GM products helped to radicalise the debate. In 1998 Greenpeace launched an "Info-conso network" with the slogan "no GMOs in my plate", listing products and brands according to whether or not they contained GM ingredients, and stigmatising those that did. It urged consumers to ask producers or distributors to adopt measures necessary to "preserve Europe and the food chain from contamination from GMOs against consumers' will". This movement was strongly relayed. To avoid a loss of market share, one by one many agro-food or mass distribution groups committed themselves to excluding GMOs in France, in Europe and sometimes even in the USA.

In this context in which many influential actors (the media, associations) denounced the risks of GMOs, hostility towards them seemed to many to "stand to reason", simply

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on the basis of information received or because that was the standpoint of the ideological movement to which they felt closest.

A risk/benefit assessment of GMOs perceived as very unbalanced

One of the causes of European opposition to GMOs is that their advantages in food production are often considered to be weak or nonexistent, while their risks are considered to be substantial (Table 5). Now, risk perception exerts a stronger influence than benefit perception (Moon and Balasubramanian, 2001).

Advantages of GMOs judged weak by many. Opponents of GMOs presented them as a technology with high potential risks and with no advantages except for the firms that developed them. They strongly emphasized two arguments:

- GMOs comprise many risks, from which no one can escape since they concern daily food and the immediate environment (Clark and Lehman, 2001). In addition some biohazards may occur such as the intended or unintended creation of virulent micro-organisms, or the creation and escape of new life forms that may endanger man and the environment. They also comprise other, more global, potential dangers and risks for farmers in developing countries and for biodiversity, which legitimises opposition and actions against them and even makes this opposition ethically essential.
- Their possible benefits will go primarily to the firms that produce them and not to society as a whole or to consumers. On the contrary, consumers' and society's safety is sacrificed.

It is not surprising that, thus presented, GMOs were met with suspicion, especially since these arguments of distrust of GMOs were perceived as credible in a context where agricultural productivism is called into question and suspicion reigned in the aftermath of some public health affairs. On the other hand, arguments which tried to present the potential advantages of genetic engineering were often rejected because perceived as hypocritical.

In the USA, where opinions were more favourable to GMOs – particularly in business, industry, agricultural, and government circles – people often thought that opposition in Europe came from its relative backwardness in this field. Or they thought that arguments on risks concealed a form of protectionism aimed at avoiding the dismantling or buy-out of European seed firms. But, while this fear may sometimes have had an influence, it stemmed not mainly

from economic protectionism since the French and other European people's rejection affected the biotechnology activities of their own countries just as much.

GMOs thus lacked supporters and allies in many European countries, including France. Moreover, in the late 1990s the public authorities adopted a hesitant attitude in this respect, often backtracking and procrastinating, which heightened confusion and perplexity (de Cheveigné et al. 2002). Thus, faced with strong denunciation by various associations, frequently relayed by the media, there were few actors to present GMOs in a favourable light: firms were judged as having little credibility and public research organizations made few public and official statements on the subject; the few scientists or their allies interviewed by the media were in some cases against GMOs; and, lastly, the authorities seemed confused and hesitant. The European and French situation is, in this respect, very different from that in the USA where GMOs usually enjoyed extensive support.

Yet abundant scientific literature has been published on the potential benefits of GMOs, generally evaluated as being greater than the foreseeable risks: more efficient agricultural production with reduced losses, increase in productive capacities in difficult conditions, improvement in various qualitative characteristics, diversification of uses of plants with the possibility to produce diverse molecules, etc. This document cannot address these questions in details; so, very few bibliographic references are mentioned here (Conway and Toenniessen, 1999; Borlaug, 2000; Interacademies, 2000; AgBioWorld, 2002). Biotechnology opens the possibility of a new path for technological development, based more on living processes and on information (knowledge) than on chemical inputs. But in Western Europe, in a context of agricultural overproduction and extensive calling into question of agricultural productivism, these aspects hardly aroused much public interest, on the contrary. Moreover, the very first products commercialised (transgenic soybeans and corn) seemed to European consumers to have little interest, but first and foremost substantial risks and weak or nonexistent advantages. In other words, even if genetic engineering could have advantages for society as a whole and for all actors, particularly by its future development (Table 6), the actors situated downstream from production – who today have considerable weight – judged it as being of negligible and often even of no interest compared to its potential and unknown risks (UK Consumers' Association, 2002). Nothing justified the use of GMOs, perceived as serving only the interests of the firms involved; any risk-taking seemed unjustified.

Factors involved in the perception of risk/benefit assessment. Concern as regards GMOs cannot simply be imputed to a lack of knowledge in biology, as many actors arguing for better education of the public have done (Miller

and Conko, 2000). In addition, the public at large cannot be accused of irrationality, as research conducted in several European countries shows (Marris, 2001; Marris et al. 2001). Various studies have enabled us to better understand risk perception. Experts evaluate it in relation to two components: the probability of an undesirable event actually happening, and the seriousness of its consequences. The public, on the other hand, takes into account a set of other factors in its assessment of risks, as many studies have shown (Slovic, 1987; Morgan, 1993; Slovic et al. 1995; Powell, 1998; Siegrist, 2000). According to their findings, a summary of these factors is presented in [Table 7](#). As a result, individual practices with serious consequences (*i.e.* cigarette smoking) cause less concern than genetic engineering which is less known, is not directly observable, is difficult to control, and where exposition to the risk is not the result of an individual choice. Acceptability thus depends on many factors related to perception of risks and to the importance of benefits that justify or offset them. But the considered risks of GMOs have been extended to a very wide field, including many socio-economic or political aspects.

As far as biotech and transgenesis are concerned, another aspect has to be taken into account in addition to the risk/benefit balance: the ethical and moral aspect, or more exactly perceptions in this domain (Robinson, 1999). These factors – perception of usefulness, riskiness and moral acceptability – were used to explain the results of previous Eurobarometer surveys on biotechnology, particularly the divergence of opinion on different biotech applications such as the agricultural ones, the medical ones, and the environmental ones (Gaskell et al. 2000). In 2002 also, if medical applications of biotechnology are perceived nearly as risky as agricultural application, they are considered much more useful and less morally condemnable ([Table 8](#)) (Amgen, 2002). Therefore, as it has been already pointed out, health applications of biotech receive better acceptance than the agricultural ones, in particular because they are considered as much more useful and more morally acceptable.

Diverse opposition to and concerns about the functioning of society and its evolution crystallized around GMOs

Limited trust in the institutions and firms involved. Genetic engineering became a widespread and frequent topic shortly after a period during which various issues of public health, food safety, agricultural pollution, etc. had arisen. The debate on genetic engineering continued throughout the period of worry about food safety, agricultural pollution and agricultural productivism, which increased concern about GMOs. They were perceived as an additional indication of negligence when it came to health and environmental hazards. The principle of precaution

therefore became an omnipresent reference, used extensively. One of the arguments often put forward by the promoters of biotechnology to justify its development is that it will be necessary for feeding tomorrow the world's population. This argument has frequently been perceived as highly hypocritical when used by multinationals – especially since these corporations adopted a policy of patenting and prohibition on the free reuse of saved seeds by farmers. This commercial policy could indeed limit poor farming communities' access to biotechnology. Furthermore, genetic engineering is often presented as increasing the risk of food dependence on major agro-exporting countries. Actually, even if genetic engineering is not the only means to examine to increase agricultural production without harm to the environment, it remains a useful tool to consider under the condition that its use is well managed (UNDP, 2001). Now, opposition groups underline the poor management of the environmental risks of GM crops such as out crossing with wild relatives, introduction of undesirable genetic traits into neighbouring crops, emergence of volunteer crop plants with multiple herbicide resistance, erosion of biodiversity, etc. Since 2000, some hassles have broken out due to the detection of seed or grain “contamination” (by transgenic genes) and to uncertainties surrounding liability issues for environmental risks (Smyth et al. 2002).

Mistrust regarding the policies of the public authorities and firms involved in the commercialisation of GMOs increased sharply. It was, moreover, fuelled by the many turnarounds and instances of procrastination which could give the impression that "they're hiding something from us" or that too many unknowns still existed. In July 2000 a majority (58%) of respondents said they tended to disagree with the opinion that "the public authorities can be trusted to make good decisions on GMOs" while 40% tended to agree (IFOP and Libération, 2000).

GMOs – symbol of negatively perceived trends. In France, biotechnology is often seen as an ultimate reinforcement of highly industrialized agriculture that has been the object of more and more criticism in the past few years. It is blamed for deterioration in the quality of foods, damage to the environment, an accelerated reduction in the number of farms, etc. This mistrust generated by the modernization of agriculture appears in the 2001 Eurobarometer survey. At the question "Do you think it is true or false that science and technology will improve farming and food production?", a quite large majority (59%) of European answered "true" and 21% "false", with great variations by country ([Figure 3](#)). France appears the most techno-skeptic, followed by Luxembourg, Italy, Austria; on the opposite, Finland, Denmark, Sweden and the Netherlands appear the most "techno-optimist" countries. Here again variations by country are greater than those by usual socio-demographic characteristics (gender,

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income or education level, place of residence, etc). In this domain, the most techno-optimist are managers, high-income people, students and highly educated people; the most dubious about science and technology are people who left school before 16 years of age, low income people, house-persons and the retired. In the first group more than 65.7% think that "it is true that science and technology will improve farming and food production" while in the second group less than 54% are as optimistic; men again appear more confident in science and technology than women.

For some people, especially many activists, biotechnology also symbolizes the negative aspects of globalisation and economic liberalism: destruction of local cultures and economies, growing trend of commodifying everything including genetic resources, and aggravated competition often perceived as disloyal due to the rivalry created between economies with different levels of development. So, certain surveys reveal that economic motives have become an important cause of opposition to GMOs (Ruffieux and Robin, 2001). Arguments put forward by active opponents show that they often perceive this struggle as a form of opposition to extreme economic liberalism. Militancy in this respect is in a sense a sort of metamorphosis of anti-capitalist militancy, or at least of protest against its excesses. Since the collapse of the communist ideal has made direct opposition to capitalism more difficult today, it seems to have found new forms of expression including, in particular, criticism of globalisation, certain aspects of consumption, technical developments, etc.

For the general public, GMOs are perceived above all as hardly useful, non-natural and risky (Eurobarometer, 2000) (Table 5). This suspicion, along with limited trust in the institutions and firms concerned, often leads to the suggestion that greater participation of citizens in scientific and technological choices would be desirable and useful. Some people believe that it would help to solve the current deadlock regarding acceptance. Others believe in the need for a renewal in democracy, as this extract from an editorial vehemently illustrates (Ramonet, 2000):

"People no longer automatically accept that scientific development is necessarily beneficial to humanity. Particularly because that progress has become inextricably tied up with money, hijacked by companies greedy for profit. (...). In addition, our decision-makers have developed a bad habit of mortgaging our collective futures without first asking us, the people. The basis of the democratic pact has thus been altered. As a result, people have become more and more suspicious. They are increasingly unwilling to give the powers-that-be the authority to play with our collective futures by rubber-stamping scientific innovations that are risky and insufficiently tested. A new spirit of distrust is abroad

among the sorcerer's apprentices of neo-scientism. (...) Shouldn't we all have a say in defining what is acceptable risk, and not just leave it to the 'experts'?"

Concluding Remarks

GMOs are the subject of a strong hostility in France and in other European countries particularly because their risk/benefit balance is perceived as particularly unfavourable and because the general public often lacks of confidence in their promoters as well as in the regulatory process. This suspicion is partly related to the context of their publicization. This topic was widely publicized at the end of the nineties; at this period, the media and general social debate had already often taken a fairly critical view. Indeed genetic engineering became a widespread and frequent topic shortly after a period during which various issues of public health, food safety, pollution, etc. had arisen. Confidence in institutions and in certain technological advances decreased considerably. A growing number of articles were devoted to these new kinds of risks. In such a context, increasing attention was paid to critical voices and to the potential risks of GMOs put forward by hostile associations. From 1997-1998 onwards and more and more thereafter, the media frequently took up and spread their arguments, at least in part. Thus the public frequently received critical, or even negative, information on genetic engineering. Opposition to GMOs stems from the many potential risks highlighted by various groups and a number of media, and from a stigmatisation of their possible advantages. By presenting themselves as defenders of consumers' interests and health, the opposition rallied a substantial proportion of the Western public who saw no advantages in GMOs.

For a certain part of people, GMOs thus seem to have become a symbol for many negative aspects of global economic development when in fact they are by no means the only forms or embodiment of that development. In this respect they differ from many other innovations that also strongly represent general economic development but the advantages of which are judged more clearly apparent by those who have access to them, and which are therefore the focus of little opposition. Indeed GMOs are accused of having negative characteristics, but quite many other products and services have similar features. In other words, the criticism of GMOs could apply to many other products, which are spared the same opprobrium. Thus, for example, the large concentration of firms in large multinational groups exists in many sectors, as does the commodifying of new activities; patents have existed for a long time for many goods that are sometimes vital. Likewise, underprivileged populations in developing countries are exposed to difficulties of access to many goods, requiring resources to obtain them or the infrastructure to produce them. As for the potential impact on the environment, it is

considerable for multiple human activities^[6]. Yet these questions are raised most forcefully for GMOs – as if they were the only subject to warrant them. GMOs are also accused of having unfavourable effects that they do not cause but express. For example, patents for the functions of certain genes are a product of economic evolution and not a requirement of genetic engineering itself.

GMOs therefore seem sometimes to play the role of scapegoat. They are accused because perceived as having little utility, unlike many other products with identical characteristics, and also because they have to do with food and nature which have a special place in human culture. Finally, GMOs are suspected in themselves, and not sufficiently in relation to the way in which they are used. It seem not sufficiently taken into account that the impact of techniques depends on the way and conditions in which they are used, the purpose given to them, the orientation of their applications, etc. (Bonny, 2000b).

In this context of high opposition, a change of attitude towards GMOs seems difficult to achieve in the EU, particularly in France. It would require them to be considered no longer as the symbol of various unpopular trends but rather for themselves, in relation to their potential and the objectives to be set for them. Above all, it would be necessary for their risk/benefit assessment to improve considerably in the eyes of various actors. The history of technology clearly shows that many innovations, after strong initial rejection, are subsequently widely diffused but with considerable improvements, especially as regards risk reduction, improved convenience of use and usefulness. This type of change of attitude regarding transgenic products in agriculture will probably be difficult in France and the rest of Western Europe because of the strength of the current opposition. Yet changes in the general socio-economic context could play an essential part by allowing GMOs to be perceived in a different light. For example, other risks could move into the foreground and make biotechnology seem to be a possible solution. In this way, climate change may highlight the advantages of more rapid varietal improvement to help to cope with it. Transgenic plants are still in their early stages and various subsequent developments could reduce their potential risks or highlight more positive aspects of this technique or its products. But could this reversal take place when some have made GMOs a scapegoat that has to be eliminated because it symbolizes trends perceived as negative? Another solution may be the development of other applications of biotechnology and life-science research which lead to new prospects for plant-breeding and farming and so make foreign gene transfer less necessary. Otherwise, what will the repercussions be of a growing divide in coming years between Europe and other areas of the world in the development of GMOs?

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APPENDIX

Tables

Table 1. In the USA, the likelihood of people buying a variety of produce if it had been modified by biotechnology, according to the date of survey (IFIC surveys).

“All things being equal, how likely would you be to buy a variety of produce, like tomatoes or potatoes, if it had been:

- i. "modified by biotechnology to taste better or fresher" [taste] (*)
- ii. "modified by biotechnology to be protected from insect damage and required fewer pesticide applications" [resistance]? (*)

Would you be very likely, somewhat likely, not too likely, or not at all likely to buy these items?"
(% of answers at each date):

Produce purchase	Type of biotech modification	Date of survey						
		Mar 1997	Feb 1999	Oct 1999	May 2000	Jan 2001	Sep 2001	Aug 2002
likely: total (a)	i/ taste	55	62	51	54	58	52	54
(a) = (b) + (c)	ii/ resistance	77	77	67	69	70	65	71
Very likely (b)	i/ taste	19	20	18	19	19	16	16
	ii/ resistance	39	34	28	30	32	25	30
Somewhat likely (c)	i/ taste	36	42	33	36	39	36	38
	ii/ resistance	38	43	39	39	38	40	41
Not too likely (d)	i/ taste	21	18	18	21	19	21	15
	ii/ resistance	11	11	11	14	14	15	10
Not at all likely (e)	i/ taste	22	19	25	22	19	21	25
	ii/ resistance	12	10	16	14	13	15	15
not likely: total (f)	i/ taste	43	37	43	43	38	42	40
(f) = (d) + (e)	ii/ resistance	23	21	27	28	27	30	25
Don't know/refused	i/ taste	2	1	6	2	4	6	5
	ii/ resistance	1	2	6	3	3	5	4

(*) In the questionnaire, no more details were given on the characteristics of the biotech modification.

Source: International Food Information Council “U.S. Consumer Attitudes Toward Food Biotechnology”, Wirthlin Group Quorum Surveys, October 1999, February 1999, March 1997, May 2000, and January 2001; Cogent Research September 2001, August 2002. <<http://iflc.org/relatives/17860.pdf>> (IFIC, 2002).

This table is reprinted (with layout modifications) from the International Food Information Council Foundation, (2002).

Table 2. Benefits expected from biotechnology in the USA.

"Do you feel that biotechnology will provide benefits for you or your family within the next five years?" (% of answers)

	Mar 1997	Feb 1999	Oct 1999	May 2000	Jan 2001	Sept 2001	Aug 2002
Yes	78	75	63	59	64	61	61
No	14	15	21	25	22	17	18
Don't know/refused	8	10	16	16	14	21	21

Source: International Food Information Council “U.S. Consumer Attitudes Toward Food Biotechnology”, Wirthlin Group Quorum Surveys, October 1999, February 1999, March 1997, May 2000, and January 2001; Cogent Research September 2001, August 2002. <<http://iflc.org/relatives/17860.pdf>> (IFIC, 2002).

This table is reprinted (with layout modifications) from the International Food Information Council Foundation, (2002).

Table 3. European attitude towards GMOs^[1].

"Would you say that you are more inclined to agree or disagree with each of the following propositions on GM foods?"
 (% of answers for each proposition; for the detailed questionnaire^[2])

Answer	"tend to agree"				"tend to disagree"				Don't know (DNK)			
	EU15	France	Max	Min	EU15	France	Max	Min	EU15	France	Max	Min
Proposition:												
I want to have the right to choose	94.6	95.2	98	87	2.5	3.1	6	1	2.8	1.7	9	1
I want to know more about this kind of food before eating it	85.9	84.1	95	79	9.3	13.1	15	4	4.8	2.8	11	2
I do not want this type of food	70.9	79.1	93	52	16.9	12.7	32	3	12.2	8.1	20	4
They could have negative effects on the environment	59.4	68.9	79	50	11.9	9.9	16	6	28.7	21.3	41	15
The dangers have been exaggerated by the media	33.1	35.6	52	22	44.3	47.5	58	29	22.6	16.9	36	10
This kind of food does not present any particular danger	14.6	15	24	9	54.8	61.5	77	38	30.6	25.5	40	8
In your opinion, is the following statement:	...true				...false				...DNK			
« GM food is dangerous »	56.4	67.6	89	38	17.1	12.4	34	3	26.5	20	32	8

NB. Max = % of answers in the EU country where this proportion is the highest.

Min = % of answers in the EU country where this proportion is the lowest.

Source: for the data on the whole EU: Eurobarometer, 2001; for the other data: Eurobarometer 55.2 unpublished results.

Table 4. Motives put forward for GMO rejection: risks, fears and reasons for refusal.

Typology developed by the author on the basis of the themes repeatedly treated in debates, articles and declarations made by the opponents.

Types of risk:	Fears and perceived risks
- troublesome, violent gene transfer process	<ul style="list-style-type: none"> - transgenesis = transgression of the barrier between species. - risk engendered by troubling the "order of the genome", which may appear only later. - insufficient knowledge of the genome to authorize such tinkering with the transfer of foreign genes (living organisms are not just "building blocks").
- health , for example Bt corn, glyphosate-tolerant soya	<ul style="list-style-type: none"> - allergies, long term toxicity. - insufficient safety tests: "consumers = guinea pigs". - gene coding for Bt toxin → consuming continuously secreted insecticide toxins. - gene coding for the enzyme which degrades glyphosate → GMOs accumulate products of degradation.
- environmental	<ul style="list-style-type: none"> - gene flow towards related wild species → "superweeds", invasive plants, accelerated decrease in biodiversity.
- agro-economic	<ul style="list-style-type: none"> - gene flow towards nearby crops of the same species → impure harvests, "contamination". - problem of volunteer plants in the following crop (rapeseed). - risk of a drop in Bt or glyphosate efficiency, interesting molecules for use in other agricultural sectors.
- economic	<ul style="list-style-type: none"> - of little interest to consumers, "product imposed" by the multinationals. - increasingly dependent agriculture (farmers must buy seeds every year). - difficulty for developing countries to access such technology (patents) => hypocrisy of saying "Genetic engineering is necessary to feed humanity." - appropriation of genetic resources by a few large multinationals. - GMOs = symbol of privatisation of all resources, now even genetic resources. - "imperialist" technology because coexistence with non- transgenic production is difficult (gene flow).
- agricultural and food production model	<ul style="list-style-type: none"> - reinforcing of the industrialized model, the limits of which have already been critically portrayed. - consumer perception: "They're playing with our health to make more money." (cf. BSE & contaminated blood).
- more socio-political motives (value systems and beliefs)	<ul style="list-style-type: none"> - innovation neither asked for nor desired, but set up solely for the profits of some multinational firms. - no respect for consumer free choice due to the presence of GMOs in many additives and fortuitous "contamination" of grain through gene flow. - media showing scientists (or associates) opposed to GMOs - vacillation in the positions taken by Public Authorities - perception "Everything is messed with more and more." → the desire to return to true nature (growing interest in organic products). - GMOs symbolize development towards a type of society which is perceived negatively. - "Such progress, why bother?" (a certain loss of faith in science and progress). <div style="text-align: right; margin-top: 10px;"> <p>} → opinion: "They're hiding something from us"</p> </div>

Table 5. How are GMOs perceived as far as risk, utility, naturalness and danger are concerned?

Eurobarometer survey 52.1, in late 1999 (Eurobarometer, 2001) (% of answers)

Items proposed:	Opinion:							
	agree		neither agree nor disagree		disagree		don't know	
	EU	France	EU	France	EU	France	EU	France
- Even if GM food had benefits, it is fundamentally unnatural.	71	82	12	9.5	10	6	7	3
- GM food threatens the natural order of things.	67	80	13	9	11	6	8	4
- If anything went wrong with GM food, it would be a worldwide catastrophe.	60	69	15	14	12	11	13	7
- GM food is simply not necessary.	56	63	18	18	17	13	9	6
- I dread the idea of GM food.	55	67	17	16	22	14	6	3
- If the majority of people were in favour of GM food, then it should be allowed.	29	20	20	20	41	54	9	6
- Of all the risks we face these days, the risk from GM food is quite small.	27	26	20	17	39	50	14	7
- The risks from GM food are acceptable.	17	10	18	21	50	61	15	8
- GM food poses no danger for future generations.	13	9	17	15	52	65	18	12

Table 6. Potential advantages of genetic engineering for different types of actors (Classification developed by the author).

Actors	Advantages
Global society	<ul style="list-style-type: none"> - new avenue of technological development based on living matter, biology and renewability, instead of being based on chemistry and fossil resources. - a means of more sustainable development in the 21st Century. - a means (among others) to cope with climate change: faster breeding of new adapted varieties, plant-chemistry instead of petroleum chemistry. - because of less production losses, the same amount of production can be obtained on a smaller area, or a greater amount on the same surface. So it is less necessary to increase cultivated area by deforestation or cultivation of new land.
Consumers	<ul style="list-style-type: none"> - potential increase in foodstuffs (interesting in LDCs), and slightly cheaper foodstuffs. - less risk from some chemical pesticides in the environment and in food. - products suited to specific demands (nutraceuticals, non-allergenic products, foodstuffs enriched or limited in certain components). - better nutritional balance for some foodstuffs. - lower prices for various vaccines and therapeutics. - improvement in the overall standard of living if the gains in productivity are shared by all.
Public authorities	<ul style="list-style-type: none"> - it help to maintain the competitiveness of biotech and seed industry in the country. - means of developing greater sustainability. - useful in contributing to solve certain problems (pollution, adaptation to climate change).
Public research	<ul style="list-style-type: none"> - biotechnology = an indispensable tool for knowledge, understanding and discovery, to allow a better comprehension of many biological mechanisms unexplained up to now.
Farmers and agronomists	<ul style="list-style-type: none"> - easier to grow (simplified treatments), greater flexibility in interventions, possible means for improving income. - decrease in losses, and better adaptation of plants to their environment. - less pollution by pesticides, mold (fungi), or impurities. - less need to increase cultivated surfaces, possibility of more sustainable agriculture.
Distribution	<ul style="list-style-type: none"> - cheaper products which can be better conserved. - supply diversification, potential increase in profit margin on products with high added value.
Food-industry firms	<ul style="list-style-type: none"> - diversified raw materials which are cheaper and better adapted to a variety of uses, with less losses.
Seed firms	<ul style="list-style-type: none"> - necessary to cope with competition and avoid the dying of French and European seed industry. - useful tool for introducing new traits into plants (resistance, composition, etc.). - allow quicker selection and better competitive resistance.
Agro-chemical & biotech firms	<ul style="list-style-type: none"> - makes it possible to go beyond the limits of chemistry; a new avenue of development. - new markets; and perhaps innovation rent allowing to develop this sector.

Table 7. Factors influencing the perception of risk.

Factors	Illustrations and clarifications
– knowledge of the risk and familiarity with it.	– An invisible or uncontrollable risk produces heightened anxiety (radioactivity, GMOs).
– scientific uncertainty, controversy	– Those who minimize the risks are suspected of having vested interests in the field (<i>i.e.</i> involved industrialists) or of trying to avoid an economic or political crisis.
– possibility of those exposed to risk to exert control over it	– The feeling of mastery is essential.
– voluntary or involuntary character of the exposition	– One is more angry about being exposed to an inescapable risk than to a risk from which one can escape (or choose for oneself).
– advantages – or disadvantages – for the person exposed	– A risk which benefits the person who creates it, but not the person who is actually subjected to it, often produces indignation.
– delay in the appearance of undesirable consequences	– A risk for which the effects seem to be very distant will be underestimated or even ignored (cf. smoking, excessive tanning).
– proximity	– A nearby risk is felt more strongly than distant catastrophes.

Table 8. Perception of usefulness, riskiness and moral acceptability of various biotech applications.

"For each of the following biotech applications, could you tell me if it is... ?" (% of answers)

Biotech applications	Proposed answers	Useful	<i>of which very useful</i>	Risky	<i>of which very risky</i>	Morally condemnable	<i>of which very condemnable</i>
– Genetic testing: detection of genetic abnormalities which might trigger diseases that parents can transmit to their children		85	64	65	27	42	21
– Gene therapy: treatment of inherited diseases by introducing a healthy functional gene in the patient body		79	48	72	27	40	16
– Human medicines or vaccines production by genetic engineering: introducing a human gene into cells or living organisms to produce medicines or vaccines		70	33	74	29	44	19
– Agricultural genetic engineering: modifying the genes of the plants to make them more nutritious, tasty or keep them longer.		29	10	69	33	54	28

(Amgen, 2002). Survey by IPSOS of a representative sample of 1021 persons in Sep. 2002 in France.

Figures

"Could you please tell me if you tend to agree or tend to disagree with this following statement about GM food:
 "I do not want this type of food" (% of answers)

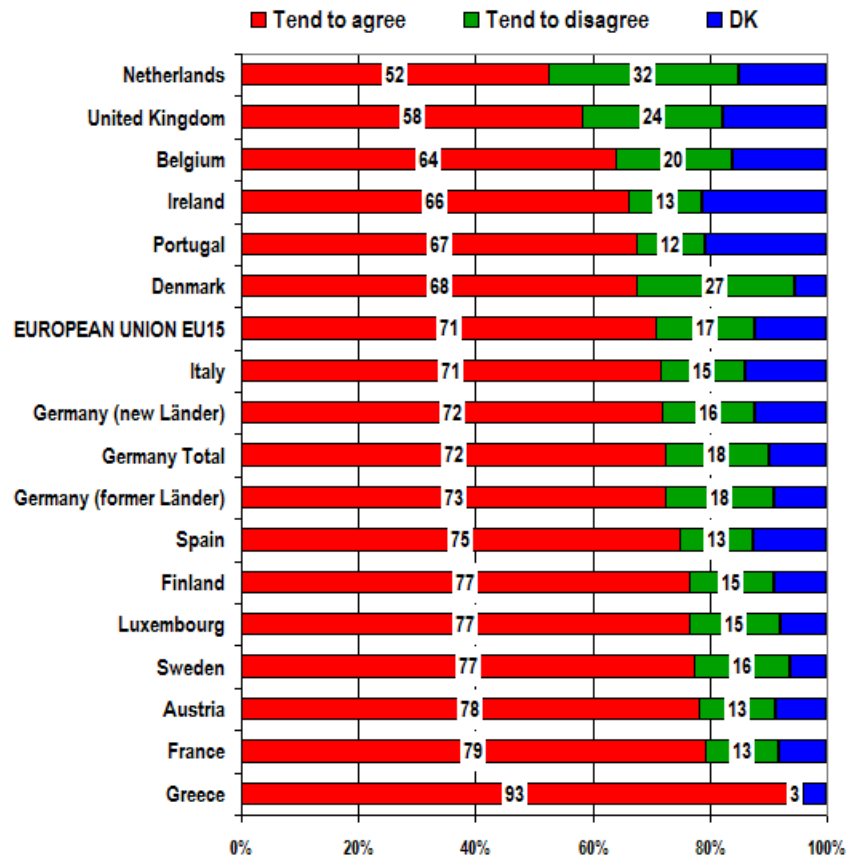


Figure 1. European opposition to GM food by country.

Source: Eurobarometer 55.2, organised and supervised by EC. Poll carried out between 10 May and 15 June 2001; 16029 people questioned, an average at some 1 000 people per Member State (Eurobarometer, 2001).

Countries are ranked by increasing level of rejection.

(DK = don't know) .

Germany (new Länder): former East Germany.

Germany (former Länder): former West Germany.

Why are most Europeans opposed to GMOs? - Factors explaining rejection in France and Europe

"Do you think that it is true or false that food based on GMOs is dangerous" (% of answers)

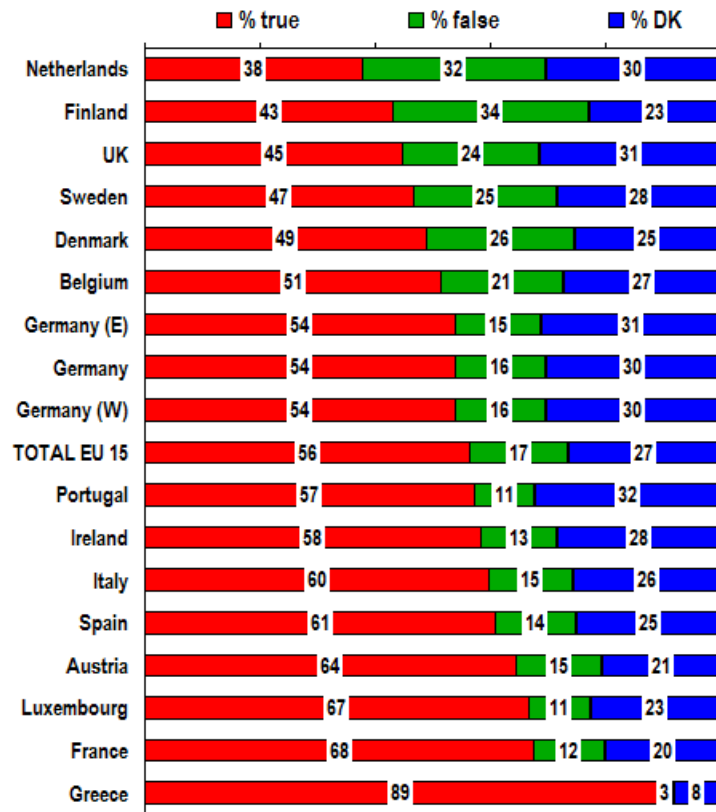


Figure 2. Opinions of GMOs by EU country.

Source: Eurobarometer 55.2, organised and supervised by EC. Poll carried out between 10 May and 15 June 2001; 16029 people questioned, an average at some 1 000 people per Member State (Eurobarometer, 2001).

Germany (E): Germany (new Länder)

Germany (W): Germany (former Länder)

Bonny, S.

"Do you think it is true or false that science and technology will improve farming and food production?
(% of answers)

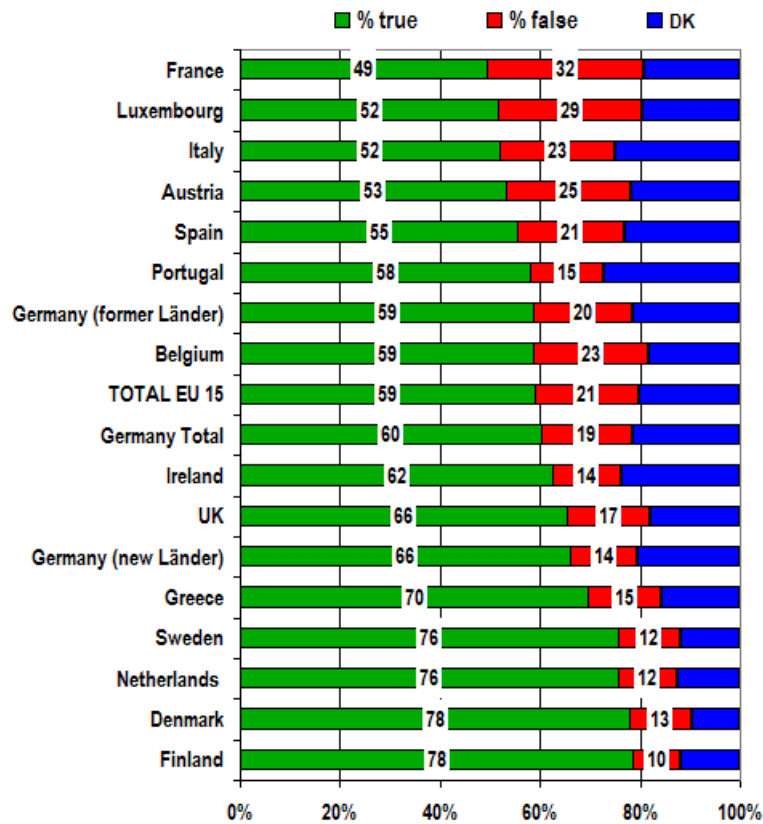


Figure 3. Opinion about the impacts of science and technology on agricultural and food production.

Source: Eurobarometer 55.2, organised and supervised by EC. Poll carried out between 10 May and 15 June 2001; 16029 people questioned, an average at some 1 000 people per Member State (Eurobarometer, 2001).

Notes

[1] More precisely a total of 16,029 people were questioned between 10 May and 15 June 2001. In each EU Member State a representative sample of the national population aged 15 and over was taken, with an average of some 1000 people per country, except in Germany (1000 in the new Länder –former East Germany– and 1000 in the former Länder –West Germany), in the United Kingdom (1000 in Great Britain and 300 in Northern Ireland) and in Luxembourg (600). This opinion poll, managed and organised by the EC Directorate-General for Press and Communication, Public Opinion Sector, has been carried out at the request of the Directorate-General for Research. It was conducted under the general coordination of EORG, the European Opinion Research Group, a consortium of market study and public opinion agencies.

[2] The questionnaires used for the Eurobarometer survey 55.2 are available at:
http://www.gesis.org/en/data_service/eurobarometer/standard_eb_profiles/data/eb_55_2.htm.

[3] To make an extremely brief summary of these affairs, we can say that in the case of "contaminated blood", through blood transfusions patients received blood products contaminated by the AIDS virus when in fact the state of knowledge at the time could have allowed this risky practice to be limited. In the case of "mad cow's disease", despite strong presumptions of risks, stringent measures on cattle feed and meat imports were sometimes taken with much delay – or were not complied with –, primarily to protect economic interests in the sector. About asbestos, although its risks had been known for a long time, it continued to be used, especially to protect the interests of this industry which was an influential player in the official body responsible for evaluating and managing risks (Kourilsky and Viney, 2000; EC-JRC, 2000; EEA, 2001; CGP, 2002).

[4]"Shut-up and eat. The farmer, the scientist and the consumer".

[5] Actually, end December 2002, the regulatory process is not yet finished. Indeed, early December 2002, EU Environment Ministers agreed the text of a draft regulation for the labelling and tracing of GMOs, clearing away a major obstacle to the lifting of the moratorium on market approvals of new GMOs. The new rules complement an agreement passed by EU farm ministers end November 2002 to allow a maximum of 0.9% of GM content in non-GM products. However, the new traceability rules must now be passed back to the European Parliament for a second reading, prior to likely adoption by the Council in the early part of 2003.

[6] Moreover, biotechnology can be considered as being able to contribute to greater sustainability, and not the opposite.