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The real and perceived risks of genetically modified organisms

The debate about the potential risks of genetically modified organisms has been going on for almost three decades without any final conclusion in sight. Why is it that the public remains critical of this technology although science has so far not demonstrated any tangible risks for human health and the environment?

Helge Torgersen

The debate about the various risks of genetically modified organisms (GMOs) has been with us for almost a lifetime, ever since a voluntary moratorium on some recombinant DNA research was declared in Asilomar, California, in 1975. Whereas the original concerns centred on the risks of GM technology in general, in recent years it has shifted to GM crops and food. Whenever an application to release or commercialise a new product is filed, European regulators are caught in a dilemma between contested claims of safety on one side, and claims of risks on the other. This has led to numerous scientific investigations, reports and assessments to establish, possibly once and for all, whether a particular risk claim is substantiated and thus relevant. But despite years of research and huge amounts of money, all attempts to bring this hardly fruitful debate to an end have been futile. GM products, apart from medicines, have not made it to the supermarket shelves in significant numbers in Europe. In this article, I will argue that, contrary to voices calling for a risk-only-based regulation, the difficulties for GM products have been aggravated exactly because these debates, regulations and policies have concentrated solely on risk and have neglected other issues.

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Although health and environmental concerns have always constituted main elements of the debate on GM crops, they are not the only problems of which the European public is wary. Many of the issues that determined the GM debate did not in fact originate from risk in a scientific understanding, but rather from a plethora of other arguments. Economic, political and religious considerations, although they have varied over time and between different countries, have played a major role from the beginning. It was not least due to these non-scientific concerns that the debate about GMOs has had so many political repercussions in Europe and continues to put its mark on the biotechnology debate today. Over the course of this debate, which has spanned more than 30 years, themes and perceptions have changed and shifted.

Media analysis is a great tool to identify different phases of the debate (Bauer & Gaskell, 2002). For instance, during the 1970s, the excitement over molecular biology as a new scientific endeavour dominated media coverage of this field. When public concerns emerged, triggered by risk claims from within the scientific community, experts were initially able to reassure the public about the safety of this new technology. However, when biotechnology's economic prospects became a main issue during the early 1980s, reporting changed profoundly. Now it was the biotech industry that had to defend itself against criticism that came from safety concerns but also from a generally critical view of industry that was in fashion at that time. What is also interesting is that promoters and opponents

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of biotechnology both began linking concerns with other contested issues, such as repercussions for healthcare and agriculture. In this way, the range of arguments extended beyond those on risks while often adding a strong national flavour and claims of potential benefits to the debate. In response to these conflicts, European governments began to regulate biotechnology in the 1980s. These national laws and regulations prompted the institutions of the European Union (EU) to promote harmonisation for the emerging common market of biotechnology products. Yet, not only the regulations, but also the particular debates, varied considerably among EU member states, which made harmonisation a difficult task. In the 1990s, biotechnology was eventually accepted—by and large—and the conflicts in most countries had died down. In fact, it looked like biotechnology was on its way to becoming a virtually uncontested industry, similar to the chemical or pharmaceutical businesses.

These first rounds of the conflicts were mostly about the industrial use of GMOs in closed containment, such as the production of pharmaceuticals. But when GM crops and GM food products emerged in the mid-1990s, environmental

and consumer protection groups took up the issue again on a broader base. As a result, old conflicts reappeared over new risk claims. Existing regulations turned out to be inadequate for GM crops, and opposition emerged even in those countries where the public had previously been fairly positive towards biotechnology. In light of this resistance, regulators pulled the emergency brake and issued a *de facto* moratorium for GM crops at the EU level. New regulations were devised to address new risk aspects. Interestingly, it is mainly the European populace that looks at GM crops and foods with suspicion—in the USA and other parts of the world, these new products met far less resistance.

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At present, the new regulatory tools seem to be not very efficient. For instance, the EU was not able to conclude whether or not to approve GM *Bacillus thuringiensis* toxin maize products after some member countries argued that unresolved risk problems would not allow them to distribute these products. However, it appears as if there were political rather than scientific reasons behind this resistance. In the present legal setting, only the European Commission is ultimately able to end such an impasse—in favour of the application, one would expect. Nevertheless, the situation with GM crops has resurrected past regulatory struggles that previously ended in limbo.

To prevent such a political stalemate, governments all over the world and international bodies, such as the EU and the Office for Economic Cooperation and Development (OECD; Paris, France), have repeatedly emphasised the importance of adequate risk regulation to ensure consumer acceptance. Such regulation needs well-defined criteria to determine when regulators should take action. This approach seems to work fine elsewhere and for other technologies, so why is it so difficult in Europe to regulate biotechnology? It is not only a problem for Europe's scientists and biotech industry, but has also led to a trade battle with the USA, whose administration has brought the dispute over GM crops to the World Trade Organization (Moore, 2003). The US administration alleges that the European regulatory approach is not properly risk-based (Miller, 1997), in other words, that science has too little, and politics too much, to say. As a result, risk gets mixed up with other issues, and political and economic arguments distort the rational scientific determination of risks as the sole basis for decision-making. If only sound science would govern this process, proponents of GM crops argue, technological progress and trade would be unhindered, as biotechnology poses hardly any new risks.

The appeal of this argument is that it is consistent and easily understood by scientists and politicians alike. It may even cater to European social science theory (Schelsky, 1965), which, although somewhat outdated, suggests that independent and disinterested knowledge is superior over interest-driven politics. Finally, and most important, only scientifically backed arguments can stand legal challenge in courts. The disadvantages are that this concept is somewhat fictitious, as we will see, and that it obviously does not work in Europe. The debate appears to go in circles with no end in sight, despite novel approaches such as traceability and segregation of GM and conventional crops.

One reason for this impasse is that it is still not clear what 'adequate regulation' means in reality. It largely depends on separating legitimate risk claims from illegitimate ones; in other words, to determine which risk is 'real' and has to be addressed and which is only 'perceived' and thus irrelevant. Obviously, it is not easy to discern a real from a perceived risk—real for whom, according to which expert and perceived by which part of the public or which stakeholder? And what exactly is the difference between real and perceived risks from a political point of view? After all, perceived risks are relevant in politics, due to their potential to mobilise the public. They are therefore real, albeit in a different way than scientists would think.

In light of these continuous and self-renewing risk claims, regulators would like to have an instrument at hand to determine, once and for all, whether a risk is real or perceived. Science seems to offer such a tool: if only those risks are acknowledged that can be scientifically demonstrated, then all other risks must be perceived and thus irrelevant. This is the conventional wisdom behind numerous expert bodies and advisory committees that have been asked to give impartial advice based on—and only on—science.

But even if reality was such that we relied on science to define risk, what if scientists come to different conclusions? Which sciences should we ask and who are the experts on which to rely? Who is a 'real' expert as opposed to one who is only 'perceived' to be one by the public or stakeholders? Who has material interests at stake and

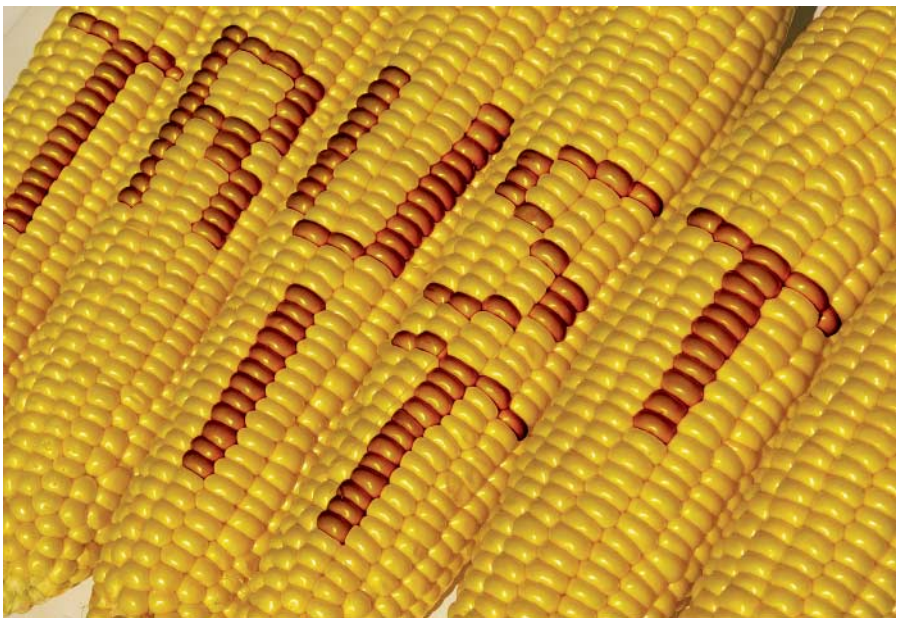
whom can we trust? Questions about the expertise and performance of individual scientists and the competence of different scientific disciplines have frequently surfaced in the public debate. Not surprisingly, often those with the best insight into the field tend to be associated with other interests, and conversely, those who are more independent seem less knowledgeable. The double-edged nature of these investigations makes it even more difficult to come to a legitimate conclusion.

In addition, critics of GM crops and foods have repeatedly argued that science has not always adequately and consistently dealt with new and contested issues. Indeed, science appeared sometimes reluctant to acknowledge the relevance of non-mainstream arguments (Gill *et al*, 1998), even if those later turned out to be substantial. Gene flow, for instance, was considered almost irrelevant in the 1980s because it was deemed a very rare event. However, it is now known as a rather common phenomenon among many organisms, GM or not, and has become an important research topic, not only because of the potential risk in the context of releasing GMOs. In a similar vein, other issues originally pushed forward by environmental or consumer activists have become mainstream topics of research and are now subject to regulatory efforts. This sequence of events seems to perpetuate itself: first, a particular risk claim appears improbable, then research gives some preliminary hints that become popularised and exaggerated, and subsequently comparisons are made to the 'normal' state of affairs. After some more inquiry, the normal state begins to look quite risky. Finally, the risk is acknowledged but put into perspective of what had hitherto been deemed acceptable. Such a sequence is the normal process of acquiring and digesting scientific knowledge, but it sometimes evokes bad memories of now commonly appraised phenomena that were formerly deemed 'irrelevant' by mainstream science.

Apart from the difficulties for science to establish the difference between real and perceived risks, there are other hurdles to an objective risk determination that would stand the test of political legitimacy. One is the very nature of risk perception. For instance, many scientists, regulators and industry managers consider risks from GMOs to be no different than risks from 'conventional' organisms. Yet, the public obviously perceives risk differently, and GMOs are often seen as menacing (Wagner *et al*, 2002). Thus, scientists often regard the public to be influenced by non-rational assumptions about highly unlikely consequences rather than by risk assessments based on the quantifiable product of impact and probability.

Social psychology has investigated this phenomenon and has come up with convincing explanations for these differences in risk perception (Slovic, 1987). Lay people assess risks quite differently than experts, but in a less irrational way than scientists assume. Risk perception depends on a variety of factors, such as its 'dread potential', that can hardly be made the subject of scientific investigation. Furthermore, the control over a new technology and whether or not a risk is accepted voluntarily plays a decisive role. Thus, risk perception depends not only on the source of risk—the organism and its properties—but also on the context: what poses a risk, who sets out to mitigate it, who benefits or suffers from it, who communicates it and how all this is done. In other words, risk and its perception is a social phenomenon rather than a scientifically determinable factor. This is not to say that risk is solely socially constructed, but it is embedded in a context that plays an important role in its appraisal or rejection.

There are other reasons why the debate is still lingering despite various attempts to influence the public's per-



ception of risk. It appears that factual knowledge of science has had little influence on attitudes (Gaskell *et al*, 2003), and campaigns to educate a seemingly ignorant public did not significantly change attitudes. Similarly, attempts to show that risks from GMOs are negligible compared with the frequently used examples of car travel and smoking have not convinced sceptics. The Eurobarometer surveys on biotechnology have repeatedly shown that a significant number of Europeans still see substantial risks with certain applications of biotechnology. This has to be accepted as a social fact, even if some consider it to be the result of non-governmental organizations' (NGOs) campaigns. After all, even those who dislike NGOs have to ask themselves why people subscribe to their arguments. One reason might be that there are so many other issues associated with or linked to the subject of GMOs that it is easy for campaigners to achieve public resonance.

Attitude research also suggests that risk perception is not the only determinant for acceptance; what also plays a major role is the perception of potential benefits (Gaskell *et al*, 2004). On average, a majority of people in Europe see risks with GM crops, and, in the absence of benefits, reject it. This is actually a rational attitude, as nobody would be so irrational as to accept a risk, real or perceived, without any possible revenues. So the question is not whether risk is low compared with other activities in which we indulge; instead, the question is what we get in exchange for accepting certain risks. Thus, acceptance of GM crops may be considerably higher in countries where benefits for consumers and producers are obvious, provided that the issue is not charged with a long history of futile ideological struggles. This is, in essence, the hope of biotechnology's promoters for the introduction of GM crops to tackle agricultural problems of developing countries. In light of the increasing efforts to export the debate to those countries, however, any benefits must be both substantial and equitable to obtain broad support for biotechnology.

But even the rational choice model has its limitations, in particular when it comes to making decisions on risks (Jaeger *et al*, 2001). Contrary to the assumption that people generally perform cost-benefit assessments, Gaskell and colleagues (2004) showed that risks of GMOs hardly played a role for a large number of respondents. Instead, benefits, or in that case the absence thereof, was the decisive factor. One must assume that for those respondents, the argument of negligible risks totally misses the point. Taken together, these findings suggest that the importance of 'objective' risk determination for public perception and acceptance has been grossly and consistently overestimated.

The most unfortunate aspect of the continuous quarrel about risk is that other, highly relevant, issues have been kept in the background. Apart from ethics, we may take the notion of benefit as a symbol for those issues. The reason why an explicit mention of benefit plays a comparatively small role in decision-making is that usually, the benefit of an innovative technology is taken for granted—if there were no benefits to it, an innovator would not engage in the costly activity of developing the technology. Restricting the debate to scientific arguments thus leaves the interest of the innovator as the normative baseline. Resistance in the past often resulted from the implicit assumption that innovation is an asset in itself, and automatically relevant for everyone. Whereas this may be less contested for other technologies, for certain applications of biotechnology it has been a recipe for failure. In risk-based regulation, there is no place for such reasoning. Consequently, if socio-economic considerations play a *de facto* role in practical decision-making, they tend to hide behind scientific risk issues as the only legitimate arguments to restrict the use of a technology

It is obvious that technology regulation based solely on risk is a limited solution, as it only reflects part of the problem. This is not to say that there is no role for it—after all, preventing unintended negative consequences is important and necessary to enable the implementation of any technology. However, only focusing on risk prevention is not enough to make a technology acceptable to a sceptical public. If its benefits and their distribution are an important determinant for acceptance, it becomes clear that we have to acknowledge the political nature of the issue. Risk-based regulation must therefore be complemented by appropriate policies.

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This may work both ways, in favour of decisions where existent perceptions and the distribution of benefits would suggest a cautious strategy, as well as in favour of taking comparatively higher risks when an urgent need could be met by a particular biotechnological solution. For example, detecting buried land mines at moderate costs with the help of modified bacteria could persuade even ingrained biotechnology opponents, in contrast to force-marketing herbicide-tolerant crops that would

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hardly find acceptance anywhere in Europe. Likewise, as already mentioned, some GM crops may well contribute to solving real problems elsewhere in the world—with an emphasis on 'some'. This may be so even if the risks associated—for example of transferring certain genes to weeds—are higher there than in Europe.

In Europe, this has been partly acknowledged, at least, in the field of GM food. The US government is therefore right in holding that provisions to ensure the 'freedom of choice', namely labelling and segregation, has little to do with risk-based regulation. But despite the criticism, it is an important result of a policy aimed at providing a credible basis for acceptance irrespective of any potential risks. Another important factor would be to determine the role of GM crops in an overall appraisal of European agriculture, in its many forms in different countries and environments and according to the many purposes it serves. A first step in this direction is an assessment of whether gene flow poses a threat to organic farming—there are massive economic and consumer interests associated with the issue, but hardly any that would legitimately fall under physical risk.

Such an appraisal would entail a general debate about the role of agriculture in each country—an initiative that is overdue not only in light of heavy subsidies. All this obviously has little to do with assessing risk using scientific instruments and procedures. But focusing solely on the latter would obscure our view of the problem. To discern real from perceived risks is, therefore, not the question highest at stake. The most pervasive risk, real and unfortunately apparent, is that we invest all our efforts into only one question, and ignore all the rest.

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Helge Torgersen is at the Institute of Technology Assessment of the Austrian Academy of Sciences in Vienna, Austria. Email: torg@oeaw.ac.at

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