

# GM crops: good or bad?

Those who choose the questions determine the answers

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There has been intense debate in the columns of *EMBO reports* and elsewhere about the rationality of the public's attitude towards genetically modified (GM) crops. Some see the public as a victim of misleading information from non-governmental organizations (NGOs) or newspapers that are seeking to increase their circulation numbers, both of which obstruct correct scientific reasoning (Burke, 2004). Others see politics as an inevitable part of the debate, involving 'actors' on all sides, including the scientists themselves (Flothmann & van Aken, 2001). Despite the heated claims that have been brought forward from both sides in the GM debate, the views of the public are seldom taken into account or investigated more closely. Is it true that public opinion is simply formed from the headlines? Do people just swallow the views of NGOs unquestioningly? How does the risk-assessment process fit into this turbulent political context? And what is the best way forward for beleaguered governments and industry?

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A large body of research on public attitudes and perceptions has direct relevance to these questions. Unfortunately, scientists who comment on the GM debate often ignore this. In particular, this research highlights the fact that public responses are more complex and sophisticated than is implied by the simplified description of being 'misinformed'. It also shows that risk assessments by scientists and regulatory

authorities are not only affected by the nature and quality of the available scientific knowledge, but also influenced in subtle and unavoidable ways by disciplinary cultures, social values, institutional priorities and economic considerations.

We start with misrepresentations of 'the public'. The concurrence of public misgivings about GM crops with campaigns by some NGOs and newspapers is sometimes taken to imply a direct one-way causal relationship (Dale, 1999). However, historically, many of the activities of the larger NGOs have been better described as following, rather than leading, public opinion. Even where they do have a formative role, large-scale NGO campaigns often have far less of an effect on public opinion than they are credited with—whether they are concerned with GM food and crops or other topics. In fact, a wide range of research into public attitudes to GM food and crops shows that people typically have a wider and more varied appreciation of the risks than is usually included in a scientific approach (Grove-White *et al.*, 1997; Marris *et al.*, 2001; Gaskell *et al.*, 2003).

The overall picture indicates a diversity of public perspectives, which makes it difficult to apply a single general idea of 'the public'. However, certain common themes arise. One is that people typically consider GM food and crops in their wider social context. Their judgements are based as much on expectations about institutional interests and organizational behaviour as on scientific or technical information. As a result of recent experiences, which are epitomized by—but not limited to—the bovine spongiform encephalopathy (BSE) episode in the UK, people tend to be less confident that industry and governments will necessarily act in the

'public interest'. This applies to all of the interested parties, including NGOs. What distinguishes the latter is not that the public simply accepts their arguments, but that the public appreciates the general role of NGOs as critical and dissenting voices. An analysis of public attitudes to biotechnology in Europe found that "NGOs, especially environmental ones, were [...] appreciated for their capacity and willingness to ask difficult questions and raise issues which would not be raised otherwise. But they were perceived as biased, just like other actors. The difference was that, compared to firms and governments, they were expected to take into account wider societal and environmental interests. But it was also recognized that NGOs have their own vested interests, such as raising funds and membership" (Marris *et al.*, 2001).

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The important finding is that public attitudes to NGOs should be seen as active and knowing, rather than passive and credulous. Although people might be critical about the details, they tend to share the broader perspectives of NGOs and value their role in raising concerns that are otherwise seen to be largely neglected.

In addition to being subtle interpreters of NGO agendas, people also tend to hold nuanced views of the media's role. Here, critical faculties are also prominent, as is a desire to see improvements. Europeans "...expressed great dissatisfaction with the

way in which the media treated these issues. The media were criticized for their 'sensationalist' approach, which focused on scandals and controversies, rather than providing more balanced background information. [...] They also wanted to be told how a particular person had reached a particular position, rather than simply being presented with conclusions and entrenched views. Moreover, focus group participants clearly expressed the desire for information about the societal implications of GMOs, and not only about the technicalities of genetic manipulation" (Marris *et al*, 2001).

Again, it is the institutional contexts, motives and justifications—rather than disembodied 'scientific facts'—that people seek to explore and influence. When we consider the differences between people who are generally supportive and those who are more cautious about GM food and crops, the underlying differences in socio-economic perspectives come into focus. "Enthusiasts tend to be more trusting of the food chain (seeing industry, government and shops as doing a good job) and believe in free market economic values (e.g. they agree to questions such as 'economic growth brings better quality of life'). The rejecters have less confidence in the food chain and are more concerned about nature and the environment. They are more likely to agree with statements such as 'nature is fragile and easily damaged'. It appears that a combination of citizen (fundamental values) and consumer (confidence in food regulation, production and distribution) concerns are likely to influence whether or not people would opt for GM" (Gaskell *et al*, 2003).

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This broader questioning of the justification for GM strategies comes up against an institutional structure that has, by and large, simply taken for granted that, whatever the wider uncertainties, GM crops are at least beneficial for agriculture (Levidow, 1994). Accordingly, policy documents that support research and development in biotechnology (CEC, 1991, 2002) are dominated by considerations of industrial competitiveness and economic growth. Although Europe put in place regulation in 1990 to protect against

possible environmental harm arising from GM organisms, this came under attack both by industry and the European Commission due to fears about its effects on economic competitiveness (Cantley, 1995). Recent revisions, which adopt a more 'precautionary' approach, were eventually negotiated because of the furore that erupted over GM crops in the late 1990s and the political pressures that this brought to bear (Mayer, 2004). We therefore see a real tension between the broader views taken by the public, and the particular interests of the biotechnology industry and key government institutions, such as the European Commission. These differences have important implications for the essentially political role that the supposedly 'scientific' procedures of risk assessment often have.

In the GM field, as elsewhere, it is becoming increasingly clear that the results obtained by 'science-based' risk assessments are highly sensitive to the particular questions that are asked, the way in which they are posed and the assumptions that are made in answering them (Amendola *et al*, 1992; Wynne, 1992; Stirling, 1997; Saltelli, 2002). Whereas experimental procedures and the analysis of data might reasonably be seen as the legitimate preserve of science, it is much more difficult to confine, in the same way, the validation of these crucial questions and assumptions (Stirling, 2003). For instance, who decides whether 'Is this safe?' or 'What would be safest?' is the most appropriate question? Should we simply assume—as is normal in risk assessment—that organizations will comply with regulations or guidance? How should we characterize 'harm' and 'who is harmed'? What priorities should we attach to different types of risk? How much attention should be given to those questions to which the answers are unknown? And what should be the level of proof and who should bear the burden of persuasion where there are uncertainties (European Environment Agency, 2001)?

These are not simply questions about the appropriate 'level of safety' to be decided at the end of an otherwise pristine scientific process. They are issues that arise at the most detailed level during the process of risk assessment itself. Whereas science might provide for great rigour in the treatment of particular methodological procedures and experimental data, the risk-assessment process typically pays little attention to the validation—or even discussion—of these

questions and assumptions. This compounds the tension between the narrow preoccupations of industry and government bodies, and the wider values and interests that are played out in the public debate. In the end, it is often the case that those who choose the questions determine the answers.

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There are innumerable examples of how this dynamic unfolds in the GM issue. Whereas scientific advisory committees typically emphasize their common ground, even in this restricted setting, the perspectives of different members generally embody radically divergent views about which issues should be included, and how they should be characterized and prioritized (Stirling & Mayer, 2001). Among other things, this scope for an entirely legitimate divergence of emphasis in the framing of risk assessment leads to marked discrepancies between the procedures that are applied—and the results that are obtained—in different countries (Levidow *et al*, 1997; von Schomberg, 1998). The normal reflex is to call for harmonization, but this simply involves the imposition of one particular set of subjective framing conditions over the others. In the end, the business of posing questions and shaping assumptions is as much about politics as it is about science.

The European risk assessment system for GM food and crops has developed through a case-by-case step-by-step approach. Hazards are characterized and their likelihoods are determined by successively larger-scale experiments. The assumption is that the resulting knowledge will allow sufficient certainty to predict the likelihood of any given hazard in commercial use. Assessments also rely on concepts of familiarity and 'equivalence', in which knowledge of the parent organism and the inserted gene is used to evaluate safety. Although there might be residual potential hazards, it is assumed that these will be mitigated by management and control systems.

As we have argued, the framing of these kinds of assessment is more uncertain and contestable than is typically acknowledged. Small-scale trials cannot replicate the full

complexity of farming and ecosystems, which poses real dilemmas for risk assessment (Parker & Kareiva, 1996). Many, including the Royal Society of Canada (2001), have also contested the usefulness of equivalence. These are specific instances of how the detailed structure of the scientific risk assessment process can raise important questions. The point here is not to criticize science, which is at the same time both essential and intrinsically open-ended—indeed, this is one of its most important features and greatest attractions. Rather, the problem lies in using scientific procedures as a way to understate persistent uncertainties, to neglect wider issues and so to help ‘close down’ criticism and debate (Stirling, 2004).

One illustration of the ‘necessary but insufficient’ status of science in the regulation of GM food and crops lies in the effect that the revision of the Deliberate Release Directive (European Commission, 2001) has had on the assessment of GM crops. The new risk-assessment process considers indirect effects that arise from changed agricultural practices associated with the GM crop, as well as the effects of the crop itself. This reflects demands for a broader assessment of the environmental effects of GM crops on commercial agricultural practices. Accordingly, it requires that a new body of data be provided when marketing consent is sought. The UK Farm Scale Evaluations (FSEs) of GM herbicide-tolerant crops were one example of the kind of new scientific study that will be required to consider how wildlife might be affected by the altered farming practices associated with the use of GM crops.

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The first results from the FSEs of GM herbicide-tolerant spring oilseed rape, beet and maize were published in the November 2003 issue of the *Philosophical Transactions of the Royal Society of London Series B: Biological Sciences*. The findings for the GM crops varied, but, in comparison with the growth of conventional non-GM varieties of spring oilseed rape and beet, significant adverse effects on wildlife were recorded.

Conversely, GM maize had beneficial effects on biodiversity. Although the study did not consider the GM nature of the crop *per se*, the modification directly changes the way in which the crop is managed and is therefore relevant from this wider perspective. However, some scientists have argued that the FSEs asked the ‘wrong question’ because they did not study the direct effects of the modification, and that the GM crops should have been compared with a conventionally bred herbicide-tolerant variety (Chassy *et al*, 2003). This is an example of an entirely legitimate debate about the type of question that should be asked in risk assessment. But this is not an exclusively scientific debate. It may also be valid to query the effects on biodiversity of growing conventionally produced herbicide-tolerant crops—this does not mean that the question is inherently wrong or unscientific when it is posed specifically in the context of GM crops.

In relation to the adequacy of data, the demands imposed by regulators and many scientists often differ from those raised by the public and NGOs. In the case of allergenicity, regulation typically places confidence in the scientific view that *in vitro* testing is sufficient to determine the likelihood of specific reactions. However, serious questions remain about the scope of these tests and their applicability to human health, and about the absence of complementary analytical or monitoring initiatives. Pressure has therefore grown, from both the public and some scientists, for improved testing procedures, which may include new *in vivo* assessment systems (Selgrade *et al*, 2003). Of course, such a move would hold real resource implications. Once again, this is not purely—or even mainly—a scientific matter. Whether greater investigation is seen as an unnecessary and costly delay, or is regarded as important for a rigorous assessment, depends on the associated benefits. ‘How safe is safe enough?’ is not a question for science alone, but depends on a wider judgement of the relative merits of a particular technology compared with its alternatives.

Similar ‘trans-scientific’ issues arise in comparing the rival knowledge claims of different scientific disciplines. For instance, molecular biologists tend to be much more confident than ecologists that potential GM hazards can be identified and predicted on the basis of the characteristics of the parent and the introduced genes. Ecologists tend

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to be more concerned that this may not capture the full complexity of the gene–organism–environment interactions, with corresponding implications for the effects that these new organisms might have on ecosystems (Wright, 1994). The question of how to weight these different bodies of scientific knowledge cannot be left entirely to the protagonists themselves.

Then there are the wider institutional, cultural and political ramifications of any new innovation. These are typically a prominent feature of public debates about technology. Most of the issues that arise have little relevance to the traditional scientific focus of risk assessment. Yet there is a tendency for governments and industry to respond disproportionately to such debates by making reference to just this kind of circumscribed risk assessment. The effect is both to diminish the scope for legitimate political debate and to further discredit the activity of risk assessment—and so, ultimately, to undermine science itself.

GM is no exception. The advent of GM technology is—among other things—leading to profound changes in the shape of the global seed industry, largely because of the potential for intellectual-property protection (Commission on Intellectual Property Rights, 2002). This has brought new, more science-intensive, industrial actors into the development and management of agricultural products. As a result, there are increasingly close links between scientists from the public sector and industry, a trend that is encouraged in much science policy making (Martin, 1999). This has obvious implications for the independence of regulatory science and the priorities that are placed on different areas of knowledge, with corresponding public concerns about the risks. But the issues extend well beyond this, and involve interests and relationships throughout the entire food-production system. Positions in this debate are not about being simply ‘pro’ or ‘anti’ technology—even GM technology. Yet a failure to address the breadth and diversity of public concerns about this issue—as with so many others—has encouraged this more polarized and acrimonious political discussion.

Just as we do not necessarily see someone who opposes a particular policy as being 'anti-policy', it makes little sense to interpret public misgivings about GM as a general anti-technology reflex. The real picture is much more complex, nuanced and diverse, with no shortage of detailed documentary evidence. The 'bottom line' for GM is that the focus and boundaries of the regulatory risk-assessment system offer a poor match to the full range of public values, priorities and concerns (Grove-White *et al*, 1997). Although recent revisions of the European GM regulatory system embody a welcome broadening of scope, there still remains a notable disjuncture with public preoccupations and expectations. The UK GM Public Debate (Heller, 2003) highlighted serious concerns over both the scope of the wider risk-assessment processes, and the lack of scrutiny of the broader justifications and purposes that are associated with GM.

If debates over GM and other new technologies are to proceed in a less polarized and acrimonious fashion, then the principal challenge lies in addressing the gap between the breadth, complexity and diversity of public concerns and the narrowness of a regulatory process that is based on the circumscribed procedures of 'scientific' risk assessment. Although the degree to which NGOs represent the public is a legitimate matter of debate, the authority of scientists to pronounce on the full range of risks, uncertainties and wider issues is equally open to challenge. The prescription of even more restrictive scientific solutions, such as provisions for rapid response to perceived inaccuracies in reporting or NGO statements (Burke, 2004), risks compounding—rather than alleviating—the problem.

In the end, the remedy for both distrust of science and opposition to GM lies in an entirely different direction. As with science, the social choice of future technological pathways is much more open-ended than is often acknowledged, and is an entirely legitimate matter for political debate. In agriculture and food production, as elsewhere, there is a need for new regulatory procedures, institutions and governance discourses. We need to recognize and include—rather than deny—the full diversity and subtlety of public aspirations and concerns about our technological future. Deciding on the questions to be asked and the comparisons to be made has to be an inclusive process and not the provenance of 'experts' alone.

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