Society and GMOs—chicken and egg?

The lessons from the GM crops debate in Europe over risk management and communication provide valuable pointers for the upcoming debate on GM animals

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Biomedical research and biotechnology have grown enormously in the past decades, as nations have heavily invested time and money in these endeavours to reap the benefits of the so-called 'bioeconomy'. Higher investments on research should increase knowledge, which is expected to translate into applied research and eventually give rise to new products and services that are of economic or social benefit. Many governments have developed ambitious strategies—both economic and political—to accelerate this process and fuel economic growth (<http://www.oecd.org/futures/bioeconomy/2030>). However, it turns out that social attitudes are a more important factor for translating scientific advances than previously realized; public resistance can effectively slow down or even halt technological progress, and some hoped-for developments have hit roadblocks. Addressing these difficulties has become a major challenge for policy-makers, who have to find the middle ground between promoting innovation and addressing ethical and cultural values.

There are many examples of how scientific and technological advances raise broad societal concerns: research that uses human embryonic stem cells, nanotechnology, cloning and genetically modified (GM) organisms are perhaps the most contested ones. The prime example of a promising technology that has failed to reach its full potential owing to ethical, cultural and societal concerns is GM organisms (GMOs); specifically, GM crops. Intense lobbying and communication by 'anti-GM' groups, combined with poor public relations from industry and scientists, has turned consumers against GM crops and has largely hampered the application

of this technology in most European countries. Despite this negative outcome, however, the decade-long debate has provided important lessons and insight for the management of other controversial technologies: in particular, the use of GM animals.

During the early 1990s, 'anti-GM' non-governmental organizations (NGOs) and 'pro-GM' industry were the main culprits for the irreversible polarization of the GMO debate. Both groups lobbied policy-makers and politicians, but NGOs ultimately proved better at persuading the public, a crucial player in the debate. Nevertheless, the level of public outcry varied significantly, reaching its peak in the European Union (EU). In addition to the values of citizens and effective campaigning by NGOs, the structural organization of the EU had a crucial role in triggering the GMO crisis. Within the EU, the European Commission (EC) is an administrative body the decisions of which have a legal impact on the 27 Member States. The EC is well-aware of its unique position and has compensated its lack of democratic accountability by increasing transparency and making itself accessible to the third sector [1]. This strategy was an important factor in the GMO debate as the EC was willing to listen to the views of environmental groups and consumer organizations.

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Environmental NGOs successfully exploited this gap between the European electorate and the EC, and assumed to speak as the *vox populi* in debates. At the same time, politicians in EU Member States were faced with aggressive anti-GMO campaigns and increasingly polarized debates. To avoid the lobbying pressure and alleviate public concerns, they chose to hide behind science: the result was a proliferation of 'scientific committees' charged with assessing the health and environmental risks of GM crops.

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Scientists soon realized that their so-called 'expert consultation' was only a political smoke screen in most cases. Their reports and advice were used as arguments to justify policies—rather than tools for determining policy—that sometimes ignored the actual evidence and scientific results [2,3]. For example, in 2008, French President Nicolas Sarkozy announced that he would not authorize GM pest-resistant MON810 maize for cultivation in France if 'the experts' had any concerns over its safety. However, although the scientific committee appointed to assess MON810 concluded that the maize was safe for cultivation, the government's version of the report eventually claimed that scientists had "serious doubts" on MON810 safety, which was then used as an argument to ban its cultivation. Francoise Hollande's government

Fig 1 | Risk assessment and risk management for GM crops in the EU. The new process for GM crop approval under Regulation (EC) No. 1829/2003, which defines the responsibilities for risk assessment and risk management. EC, European Community; EU, European Union; GM, genetically modified.

has adopted a similar strategy to maintain the ban on MON810 [4].

Such unilateral decisions by Member States challenged the EC's authority to approve the cultivation of GM crops in the EU. After intense discussions, the EC and the Member States agreed on a centralized procedure for the approval of GMOs and the distribution of responsibilities for the three stages of the risk management process: risk assessment, risk management and risk communication (Fig 1). The European Food Safety Authority (EFSA) alone would be responsible for carrying out risk assessment, whilst the Member States would deal with risk management through the standard EU comitology procedure, by which policy-makers from Member States reach consensus on existing laws. Finally, both the EC and Member States committed to engage with European citizens in an attempt to gain credibility and promote transparency.

More than 20 years after this debate, the claims made both for and against GM crops have failed to materialize. GMOs have neither reduced world hunger, nor destroyed entire ecosystems or poisoned humankind, even after widespread cultivation. Most of the negative effects have occurred in international food trade [5], partly owing to a lack of harmonization in international governance. More importantly, given that the EU is the largest commodity market in the world, this is caused by the EU's chronic resistance to GM crops. The agreed centralized procedure has not been implemented satisfactorily and the blame is laid at the door of risk management (http://ec.europa.eu/food/food/biotechnology/evaluation/index_en.htm). Indeed, the 27 Member States have never reached a consensus on GM crops, which is the only non-functional comitology procedure in the EU [2]. Moreover, even after a GM crop was approved, some member states refused to allow its cultivation, which prompted the USA, Canada and Argentina to file a dispute at the World Trade Organization (WTO) against the EU.

The inability to reach agreement through the comitology procedure, has forced the EC to make the final decision for all GMO applications. Given that the EC is an administrative body with no scientific expertise, it has relied heavily on EFSA's opinion. This has created a peculiar situation in which the EFSA performs both risk assessment and

management. Anti-GM groups have therefore focused their efforts on discrediting the EFSA as an expert body. Faced with regular questions related to agricultural management or globalization, EFSA scientists are forced to respond to issues that are more linked to risk management than risk assessment [5]. By repeatedly mixing socio-economic and cultural values with scientific opinions, NGOs have questioned the expertise of EFSA scientists and portrayed them as having vested interests in GMOs.

Nevertheless, there is no doubt that science has accumulated enormous knowledge on GM crops, which are the most studied crops in human history [6]. In the EU alone, about 270 million euros have been spent through the Framework Programme to study health and environmental risks [5]. Framework Programme funding is approved by Member State consensus and benefits have never been on the agenda of these studies. Despite this bias in funding, the results show that GM crops do not pose a greater threat to human health and the environment than traditional crops [5–7]. In addition, scientists have reached international consensus on the methodology to perform risk assessment of GMOs under the umbrella of the *Codex Alimentarius* [8]. One might therefore conclude that the scientific risk assessment is solid and, contrary to the views of NGOs, that science has done its homework. However, attention still remains fixed on risk assessment in an attempt to fix risk management. But what about the third stage? Have the EC and Member States done their homework on risk communication?

It is generally accepted that risk management in food safety crucially depends on efficient risk communication [9]. However, risk communication has remained the stepchild of the three risk management stages [6]. A review of the GM Food/Feed Regulations noted that public communication by EU authorities had been sparse and sometimes inconsistent between the EC and Member States. Similarly, a review of the EC Directive for the release of GMOs to the environment described the information provided to the public as inadequate because it is highly technical and only published in English (http://ec.europa.eu/food/food/biotechnology/evaluation/index_en.htm). Accordingly, it is not surprising that EU citizens remain averse to GMOs. Moreover, a Eurobarometer poll lists GMOs as one of the top five environmental issues for which

EU citizens feel they lack sufficient information [10]. Despite the overwhelming proliferation of scientific evidence, politicians and policy-makers have ignored the most important stakeholder: society. Indeed, the reviews mentioned above recommend that the EC and Member States should improve their risk communication activities.

What have we learned from the experience? Is it prudent and realistic to gauge the public's views on a new technology before it is put into use? Can we move towards a bioeconomy and continue to ignore society? To address these questions, we focus on GM animals, as these organisms are beginning to reach the market, raise many similar issues to GM plants and thus have the potential to re-open the GM debate. GM animals, if brought into use, will involve a similar range and distribution of stakeholders in the EU, with two significant differences: animal welfare organizations will probably take the lead over environmental NGOs in the anti-GM side, and the breeding industry is far more cautious in adopting GM animals than the plant seed industry was to adopt GM crops [11].

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GloFish®—a GM fish that glows when illuminated with UV light and is being sold as a novelty pet—serves as an illustrative example. GloFish® was the first GM animal to reach the market and, more importantly, did so without any negative media coverage. It is also a controversial application of GM technology, as animal welfare organizations and scientists alike consider it a frivolous use of GM, describing it as “complete nonsense” [18]. The GloFish® is not allowed in the EU, but it is commercially available throughout the USA, except in California. One might imagine that consumers in general would not be that interested in GloFish®, as research indicates that consumer acceptance of a new product is usually higher when there are clear perceived benefits [13,14]. It is difficult to imagine the benefit of GloFish® beyond its novelty, and yet it has been found illegally in the Netherlands, Germany and the UK [15]. This highlights the futility of predicting the public's views without consulting them.

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Consumer attitudes and behaviour—including in regard to GMOs—are complex and change over time [13,14]. During the past years, the perception from academia and governments of the public has moved away from portraying them as a ‘victim’ of industry towards recognizing consumers as an important factor for change. Still, such arguments put citizens at the end of the production chain where they can only exert their influence by choosing to buy or to ignore certain products. Indeed, one of the strongest arguments against GM crops has been that the public never asked for them in the first place.

With GM animals, the use of recombinant DNA technologies in animal breeding would rekindle an old battle between animal welfare organizations and the meat industry. Animal welfare organizations claim that European consumers demand better treatment for farm animals, whilst industry maintains that price remains one of the most important factors for consumers [12]. Both sides have facts to support their claims: animal welfare issues take a prominent role in the political agenda and animal welfare organizations are growing in both number and influence; industry can demonstrate a competitive disadvantage over countries in which animal welfare regulations are more relaxed and prices are lower, such as Argentina. However, the public is absent in this debate.

Consumers have been described as wearing two hats: one that supports animal welfare and one that looks at the price ticket at the supermarket [16]. This situation has an impact on the breeding of livestock and the meat industry, which sees consumer prices decreasing whilst production costs increase. This trend is believed to reflect the increasing detachment of consumers from the food production chain [17]. Higher demands on animal welfare standards, environmental protection and competing international meat producers all influence the final price of meat. To remain competitive, the meat industry has to increase production

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per unit; it can therefore be argued that one of the main impetuses to develop GM animals was created by the behaviour—not belief—of consumers. This second example illustrates once again that society cannot be ignored when discussing any strategy to move towards the bioeconomy.

In conclusion, we believe that functional risk management requires all three components, including risk communication. For applications of biotechnology, a disproportionate amount of emphasis has been placed on risk assessment. The result is that the GMO debate has been framed as black and white, as either safe or unsafe, leaving policy-makers with the difficult task of educating the public about the many shades of grey. However, there are a wide range of issues that a citizen will want take into account when deciding about GM, and not all of them can be answered by science. Citizens might trust what scientists say, but “when scientists and politicians are brought together, we may well not trust that the quality of science will remain intact” [18]. By reducing the debate to scientific matters, it is a free card for the misuse of science and has a negative impact on science itself. Whilst scientists publishing pro-GM results have been attacked by NGOs, scientific publications that highlighted potential risks of GM crops came under disproportionate attacks from the scientific community [19].

Flexible governance and context need to work hand-in-hand if investments in biotechnology are ultimately to benefit society. The EU's obsession with assessing risk and side-lining benefits has not facilitated an open dialogue. The GMO experience has also shown that science cannot provide all the answers. Democratically elected governments should therefore take the lead in communicating the risks and benefits of technological advances to their electorate, and should discuss what the bioeconomy

really means and the role of new technologies, including GMOs. We need to move the spotlight away from the science alone to take in the bigger picture. Ultimately, do consumers feel that paying a few extra cents for a dozen eggs is worth it if they know the chicken is happy whether it is so-called ‘natural’ or GM?

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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