Science and Public Policy, 36(4), May 2009, pages 287–299
DOI: 10.3152/030234209X436527; http://www.ingentaconnect.com/content/beech/spp

What do civil society organisations expect from participation in science? Lessons from Germany and Spain on the issue of GMOs

Maria Paola Ferretti and Vincenzo Pavone

Recent debates in science and technology studies, as well as more practical approaches to science policy both at national and European level, have stressed the relevance of citizen participation in the field of science. This paper investigates what some of the key actors in this debate, civil society organisations, expect from participation. The paper presents two case studies of civil society participation in the field of novel biotechnologies in Germany and in Spain. Despite the differences between the experiences of participation in these two countries, our study shows that current institutional approaches, which are inspired by the 'democratisation of expertise' perspective and set up essentially at the 'downstream' level, seem less promising than 'upstream' models of participation, which, in contrast, appear more meaningful from a 'co-production of science' framing.

PARTICIPATORY EXERCISES in science policy and in the regulation of science are increasingly popular. In the late 1990s various governments started explicitly to recognise the need of rendering decision-making processes more open to public input (NHI, 1998; EC, 2001). These were justified by the will to prevent technocratic drift and as a reply to societal demand and contestation of public uses of science (Irwin and Wynne, 1996). However, programmatic documents did not clarify which mechanism can best facilitate public input in science policy. A highly fragmentary involvement of various sectors of the public (sometimes referred to as 'publics') is scattered across a wide spectrum of complex institutional frameworks while, across Europe, a significant variety of participatory practices can be observed experimenting with various ways of engaging the public (Bora and Hauseldorf, 2006; Evans and Plows, 2007). Most importantly, the evaluation of various participatory exercises promoted in Europe reveals that, despite the high rhetoric about the need for public participation, their impact in the decision-making process and in enhancing trust in institutions is rather disappointing (Rothstein, 2004; Steffek *et al*, 2007). Various attempts recently experimented with in Denmark, Germany, UK and other countries have shown a significant escalation of conflicts among the various stake-holders (Bora and Hauseldorf, 2006). Such conflicts highlight profound differences not only among the values defended by the various actors, but also in the very concept of participation in science and its functions.

This study is designed to shed light on the way participation in science is understood and enacted by a number of civil society organisations (CSOs). Various CSOs have grown in importance and influence (Greenwood, 1997; Börzel, 1997) and, in certain specialised fields such as that of novel biotechnologies, they have mobilised European public opinion (Bernauer, 2003; Marris *et al*, 2001; Bauer and Gaskell, 2002).

For this reason, we believe that the experiences of participation (or lack of participation) by CSOs and their expectations are crucial in understanding

Dr Maria Paola Ferretti is at the Centre of European Law and Politics (ZERP) at the University of Bremen, Universitätsallee GW1, D- 28358 Bremen, Germany; Email: ferretti@iniis.uni-bremen.de; Tel: +49 421 218 4779. Vincenzo Pavone is at the Institute of Public Policies, Centro de Ciencia Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC), Calle Albasanz 26-28, E-28037 Madrid, Spain; Email: vincenzo.pavone@cchs.csic.es.

 0302-3427/09/040287-13 US$12.00

Maria Paola Ferretti is lecturer in political theory at the University of Bremen, Germany. She studied philosophy in Italy (MA Pavia) and political theory in the UK (MA York; PhD Manchester). She has published a number of articles on normative approaches to risk governance and novel biotechnologies, including: Why public participation in risk regulation? The case of authorising GMO products in the European Union, *Science as Culture* **16**(4) (2007); More politics, stronger consumers? The new division of responsibility for food in the European Union (with F Bergeaud), *Appetite*, **47**(2) (2006); Accountability or 'good decisions'? The competing goals of civil society participation in international governance (with J Steffek), *Global Society*, **23**(1) (2009). Her main research interests are public ethics, political and legal philosophy.

Vincenzo Pavone is research fellow in social and political sciences at the Institute of Public Policies of the National Research Council (CSIC) of Spain. He studied political science at the University of Catania, Italy, and at the University of Kent, UK. He completed his PhD at the European University Institute of Florence, Italy. Recent publications include: *From the Labyrinth of the World to the Paradise of the Heart: Science and Humanism in UNESCO's Approach to Globalization* (Lexington Books, 2008); From intergovernmental to global: UNESCO's approach to globalization, *Review of International Organizations*, **2**(1) (2007). His main research interests are the political and social aspects emerging around the complex relationship between science, politics and society, with a special focus on biotechnologies, participatory governance and the so-called bio-based economy.

conflict escalations and, hopefully, in indicating a potential way out of such conflicts.

Whether we think that CSOs are legitimate interlocutors or not, as a matter of fact, they occupy today a very important role in the debate on participation in science (EC, 2007). CSOs have been privileged partners of institutions in scientific production/regulation through the provision of their scientific and social expertise; but they also contribute to science policy debates and social developments as a result of their social and political mobilisation (Levidow *et al*, 2005: 267). On the one hand, specialised CSOs contribute to the technical and scientific debate with independent experts while their link with members and activists provides them with local knowledge and ethical/social perspectives, not only in relation to the debate on genetically modified organisms (GMOs) (Levidow, 2007) but also in the emerging debates on technological innovation and health policy (Doyle and Patel, 2008). On the other hand, disappointed with experiences of institutional participation, they have introduced a new strategy largely based on information campaigns and organisation of independent summits where they set their own agenda and directly address the public (Thoyer and Martimor-Asso, 2007).

However, if discontent with participation emerges quite clearly from the aforementioned assessment studies, little has been written about how CSOs understand participation and what they expect from it. Despite the fact that the growing role of these organisations is widely recognised in the literature, their views on the matter are rarely investigated as CSOs have been very reluctant to disclose strategic information about their aims, strategies, hopes and disappointments.

We have collected information and perspectives on these themes by asking a number of CSOs active in the debate over novel biotechnology applications in Germany and Spain. Novel biotechnologies in general and GMOs in particular have in recent years become a classic example for assessing the scope of public participation (Rothstein, 2004; Borrás, 2006; Levidow, 2007; Ferretti, 2007). The selection of Germany and Spain was motivated by the observation that these two countries are located at the opposite poles of an imaginary continuum that spans from no institutional effort to introduce public participation (Spain) to a strong and explicit commitment towards the implementation of participatory mechanisms (Germany). While in Germany participatory exercises in the field of biotechnology have been experimented with since the mid-1990s, in Spain institutional initiatives to foster participation have been very rare and interventions in the debate have followed mainly other channels, such as public information campaigns, consumer support actions and promotion of alternative research. Germany's focus on corporate solutions and consensus (Katzestein, 1987) and Spain's expert-based approach (Todt, 1999) not only reflect the deep differences between the two political cultures with regards to civil society participation in science and technology governance, but they also bear witness to the development of the public debate over GMOs cultivation in the two countries.[1]

The data presented in this paper were generated through a qualitative analysis of a total of 32 interviews between Germany and Spain (see Appendix 1), conducted between June and November 2007. Since there is no uncontroversial definition of CSOs,[2] it is worth specifying that our interviewees include representatives of environmentalist non-government organisations (NGOs), church organisations and voluntary associations aiming at scientific information; consumer associations and farmers' organisations.

The semi-structured interviews aimed at soliciting CSOs' evaluations of participatory exercises in which they took part, and explanation of the factors they regarded as hindering or enhancing participation. We asked them about their favoured strategies for intervening in the GMOs debate and their perspectives on participation in science. In particular we focused our questions on two types of participation:

1. Participation at the initiative of political or regulative institution (which often comes as a by-product of the 'democratisation of expertise' approach); and
2. Broader initiatives aimed at making a contribution to the scientific debate and to the directions of

science (which are usually taken into account only from a 'co-production of science' perspective).

The remainder of this article is organised as follows. The second section introduces two main models of conceiving of participation in science: 'democratisation of expertise' and 'co-production of science'. These two categories will be used in our study to analyse the qualitative data. In particular we will ask to what extent CSOs conceptions of participation are congruent with either one or the other interpretative framing. The third and fourth sections present the interview data from Germany and Spain respectively. These data, coupled with the information coming from secondary literature, help us to cast some light on the different outcomes experienced in the two countries, in terms of both attitudes and strategies related to institutional participatory mechanisms as well as informal exchange of scientific and societal knowledge. The fifth section asks what can be learned from the interviews in terms of how to conceive participation in science.

Democratisation of expertise and the co-production of science

Participatory approaches both to science policy and science regulation so far have been proposed mainly to prevent technocracy, improve democratic accountability, encourage dialogue between scientists, policy-makers and the public, and secure stronger support to science and innovation systems (EC, 2001, 2007). These common aims, however, can be pursued in different ways, depending on whether we follow a narrower or a broader understanding of participation, which we will refer to as 'democratising expertise' and 'co-production of science' models.

Democratising expertise

Concerning the threat of technocracy, it has been noted that governments increasingly rely on scientific expertise in order to deliver good regulation (Weingart, 1999). When decisions are based on 'sound science', they are taken to be authoritative and thereby acquire legitimacy (Joerges and Neyer, 2003; Nowotny, 2003). On the one hand, scientific judgment promises to bring neutrality in decision-making whereas politicisation leaves outcomes in the hands of those who can exert greater decisional power (Kerr *at al*, 1997). On the other hand, several observers have remarked that often government-appointed experts, in fact, shape political decisions under the disguise of scientific advice (Weingart, 1999, Todt and Luján, 2000).

With a view of preventing these technocratic drifts and securing public support for science, various participatory schemes have been proposed and implemented in decision-making about science and technology innovation (Rowe *et al*, 2008). Often inspired by a 'democratisation of expertise approach', these schemes defend the possibility, and suggest the necessity, of enacting new cooperative schemes of mutual learning between scientists and citizens to contribute to a wider definition of the issues at stake as well as to the formulation of viable solutions (Liberatore and Funtowitcz, 2003).

While there are numerous theoretical works and empirical applications of the democratisation of expertise approach, quite different from one another, the core characteristics defining this approach may be summarised as follows:

- Democratisation of expertise represents an institutional effort to include actors that were previously excluded from decision-making processes involving scientific information and advice.
- It focuses on participation in institutional setting (e.g. science committee and *ad hoc* consultations), usually at the invitation of political authorities.
- It concerns a specific area of science, elsewhere defined as 'post-normal science' (Funtowicz and Ravetz, 1992), characterised by *high uncertainty* – such as agrofood biotechnology and medical genetics.
- It aims at fostering *transparency* and *public information*.
- It recommends *broadening expertise* to non-academic researchers and practitioners and *establishing guidelines for the selection of the experts* appointed in science committees (Carolan, 2008).

Examples of the application of this approach can be found in a number of participatory technological assessments (PTAs), which, at the invitation of scientific institutions, generally aim at achieving a scientific consensus on some technical questions by arguing between experts and counter-experts (Pellizzoni, 2001; Abels, 2007) or, sometimes, by including lay perspectives. Conceived in these terms, participation focuses on bringing citizens closer to the place of the decision-making and taking into account perspectives and kinds of expertise that are otherwise ignored.

Participatory approaches both to science policy and science regulation so far have been proposed mainly to prevent technocracy, improve democratic accountability, encourage dialogue between scientists, policy-makers and the public, and secure stronger support to science and innovation systems

Emerging and consolidating during the 1990s, the 'democratisation of expertise' approach has been charged with neglecting important questions:

- Why were certain technologies developed in the first place?
- Who is to be considered a legitimate stakeholder?
- What type of knowledge is to be accepted as relevant?
- How have the processes of knowledge production emerged and been organised?

Some scholars (Wynne, 2002; Carolan, 2008), point out that the democratisation of expertise approach frames the issues at stake in regulatory terms, largely emphasising the 'how' questions at the expenses of the 'ought' questions. Others (Mayer, 2003; Ellis and Waterton, 2004; Martello, 2004) hold that it is not sufficient to grant citizens access points in cognitive processes, but it is necessary to question how the scientific debate was framed in the first place.

Co-production of science

A somehow complementary, albeit more radical, perspective on participation in science, inspired by Sheila Jasanoff's analytical model of the *co-production* of science (1996, 2004), has been advanced by several authors (Wynne, 2006, Felt *et al*, 2007). From a co-production perspective, science and technology are the result of a process in which social, political and scientific actors interact and finally determine the directions, the priorities and the advances of the scientific activity. The issue, therefore, is not so much about creating new formal mechanisms of participatory practices but, rather, imaginatively setting the stage for new forms of knowledge production, in which policy-makers, scientists, corporate producers and the public may meaningfully interact (Jasanoff, 2003: 238).

Although Jasanoff's account of co-production was mostly analytical and it was not immediately clear which normative implications might follow from it, some suggestions have recently been made to translate these ideas into participatory practices. Some authors proposed setting public engagement with science at an early stage, or *upstream* (Wilsdon and Willis, 2004; Stirling, 2006). Others suggested involving citizens and concerned groups in the production of knowledge that they may directly employ (Felt *et al*, 2007). This would encourage self-reflexivity among institutional actors, scientists and policy-makers involved in knowledge production (Wynne, 2006) and confer publicity to assumptions, visions and values associated with technology (Macnaghten *et al*, 2005).

From a co-production perspective, participation in science has to address crucial questions about power relations — often neglected by the democratisation of expertise approach — and ask, for instance, whether in the processes of knowledge production and regulation some actors hold a dominant position or all parties have fair access points and influence. In this perspective science is understood as a broad societal system in which the scientific community and its methods play an important but no longer unique role. Moreover, a co-production perspective focuses not only on institutionalised practices of participation but also takes into account a wider range of activities including public debates, encouraging or boycotting the commercialisation of products, and debating the definitions of science and its priorities as set by the regulatory institutions.

Our hypothesis, therefore, is that a co-production perspective, offering an interpretative framework that addresses the actual dynamics of science production and participation, is better equipped to understand the variety of CSO approaches to participation in science. In the light of this hypothesis, we shall analyze the interview data in the following two sections. Where the interviewees gave their consent, the name or acronym of the CSOs they represent is given in brackets after each quotation.

The role of civil society organisations in the German debate

Germans started debating biotechnology relatively early with respect to other European countries and relatively early came various institutional attempts to involve the public in the debate on GMOs (Gottweis, 1998; Hampel, 1998; Marris *et al*, 2001). At the same time it has been remarked (Brendle and Hey, 1992; Gill, 1993), and it is confirmed by our interviews, that German CSOs, compared to other European organisations, are particularly suspicious exactly because of the experiences and the outcomes of these participatory exercises. Despite inevitable individual variations, German CSOs' perception of participation can be summarised by this quote from one of the interviews:

> Unfortunately the public is asked to agree with scientists. In this way participatory processes are not really open to people's input and proposals. What is more is that there is the unbalance of power in term of means and expertise of the industry compared to the people. (*Biokreis Erzeugerring*)

Coupling the history of PTA in Germany with the interviews data, it is possible to identify some crucial factors that have been often overlooked when studying or advocating participation in science.

Germany has a long tradition of inclusion of pressure groups and associations in policy-making, and the field of science and technology is no exception. After a brief phase in which novel biotechnologies were uncritically regarded as an economic opportunity not to be missed, already at the beginning

of the 1990s specialised CSOs, and in particular Greenpeace, played an important role by raising an awareness of the ecological, social and ethical risks linked to biotechnologies and by leading the campaign against GMO products. A couple of years later, consumer associations too became more vocal in their opposition to GMOs. At the institutional level, various initiatives were taken with the aim of establishing specialised communicative strategies for addressing the public controversy on novel biotechnological applications. However, in several cases the interaction between CSOs and both political institutions and scientists has proven difficult.

For example, the project 'Discursive Procedure for the Technology Assessment of Crop Plants with Genetically Engineered Herbicide resistance' (1991–1993) was organised by the Wissenschaftszentrum Berlin in cooperation with various universities and research centers and financed by the Ministry for Research and Technology. In 1995 a Citizen Forum on Biotechnology and Genetic engineering was organised by the Academy of Technological Assessment in Baden-Württemberg, with the aim of assessing the potentialities of the new technologies for German industry.

Despite the explicit Habermasian inspiration,[3] in both these cases, the outcome in terms of participation was rather disappointing, according to most observers (Bora and Van den Daele, 1997, Skorupinski and Ott, 2000). In particular in the 1995 event, the environmental organisations involved withdrew from the project, protesting against the deficit of democratic structure. In contrast, the organising institution claimed that the withdrawals were due to CSOs' failure to accept the rules of the game and to recognise the weakness of their arguments. In fact, CSOs contested that stakeholders were invited to discuss risks and benefits of particular technologies, but not to call into question those technologies in themselves. They found that the key question was whether alternative methods and technologies could provide better solutions to the problems that government and industry proposed to address by means of new biotechnological applications (Van den Daele, 1995). CSOs wanted to be able to set the terms of the debate, rather than simply being asked to 'agree or disagree with scientists' (Wynne, 2002).

In Germany, civil society organisations contested that stakeholders were invited to discuss risks and benefits of particular technologies, but not to call into question those technologies in themselves

In fact, it has been argued that CSOs found themselves in a 'participation trap' and only by withdrawing were they able to 'devote greater resources to public protest and preserve their credibility with NGO members' (Gill, 1993: 81–82). This element points to an ambiguity of participation for CSOs. Sitting at the institutional table and talking directly with the public are two very different forms of participation, as we shall discuss further below.

In the first participatory exercises described, the criticisms focused mainly on the ways in which participation was organised. CSOs were hoping to have the possibility of some agenda-setting power and to be more involved in the process, rather than being invited simply as an audience.

More successful, at least in terms of participatory procedures, was the forum on green genetic biotechnologies, the *Diskurs Grüne Gentechnik* (December 2001–September 2002). Under the auspices of political forces largely sympathetic to the environmental moments involved (in particular the leadership of the Ministry for the Environment, *Renate Kunast*), 30 organisations and associations were made part of the process from the very beginning, to give them the opportunity to decide both the discussion themes and the list of experts to be involved. Given the heterogeneity of the invited groups and their rival claims, setting the agenda in a logically coherent structure and preparing a list of experts to be invited turned out to be very difficult tasks (Hammerbacher, 2003). Concerning the agenda, convergence could be reached only on five very broad headings

- Maintenance of biodiversity;
- Potential for innovation and future scenarios of green gene technology;
- Benefits and risks for consumers and producers;
- Preconditions, chances and consequences of giving up green biotechnology; and
- Information, public participation and freedom of choice.

The selection of experts suffered from the relative power acquired by organisations located at the extreme poles of the debate (Hansen, 2006). Following the proposal of GM skeptics (who were mainly interested in breaking what they perceived as the hegemony of mainstream science), the experts were recruited according to a pro/contra proportional principle. Thus, although the intention was to give representation to all points of view, the appointed experts reproduced the polarised positions of the organisations invited. As an effect of this polarisation, the outcome was that consensual decisions were reached only on some very general and abstract points, while on more substantial matters the participatory exercise once again proved the persistent division of the actors involved. In their feedback, the organisations involved praised the process, but the judgments on the outcomes were much less enthusiastic (Hansen, 2006).

If the first participation experiments presupposed a discussion on technology without politics, bringing in political and ethical values did not in fact help bring the parties closer. The conflict between science and public interests is most often presented by CSOs as a problem of sponsorship and economic interests linked to research in genetic technologies:

> The public is not desired. Here the problem is that the one who pays also is the one who decides what will be on the research agenda. Though the public is concerned as a tax payer, it is definitely not called into question. And who has the money? Again, the industry financing its projects with it … Genetic engineering and its applications are primarily about economy and money. The guarantee for that are patents, and it doesn't matter whether they are legitimate or not. (*Kein Patent auf Leben*)

The difficulties in overcoming these material obstacles to effective inputs 'from below' results in a general disenchantment with the possibility of achieving mediation on a theme so controversial as GMOs, which emerges clearly from our interviews:

> There are theories concerning genetic engineering … and the conflicts cannot be easily resolved by means of dialogue. These are systems of values. Dialogue can do relatively little about that. (Anonymous)

Yet if participation cannot be designed to achieve public acceptance of the work of scientists, let alone mediation and dialogue, does it still make sense to talk about participation? Yes, the answers emerging from the interviews seem to be, but it is a very different sort of intervention in the debate. Quite far from the idea of a couple of CSO representatives sitting with other stakeholders around a table at government invitation, CSOs take initiative and directly address the public. Changes in people's attitudes towards GMOs are generated by mobilising large numbers by demonstrative actions and by lobbying.

> A good example is a campaign which the *BUND* has mounted and still is mounting. The campaign has the name 'GM-free regions'. The *BUND* — just to explain — is speaking up for a GM-free agriculture. We do not wait for politics, but try to realize it by ourselves. We succeeded with our campaign 'GM-free regions' to the extent that now more than 25,000 farmers allied and say: 'Genetic technology has no hope in our agricultural area!' (*BUND*)

All these activities aim at influencing the public debate and science policy before the legislative and regulative process is initiated:

> What is important is acting through federations and organizations, in cooperation. So it is possible to influence the work they are doing in Berlin and Bonn, before legislation on these issues is passed. (*Agrarbündis*)

Once legal and juridical frameworks are set, intervention is more difficult. As long as institutionalised participation exercises require CSO representatives to sit as experts among experts and accept certain common framing of the questions, they prefer a more direct radical critique to the official (i.e. governmental) way of addressing the question:

> We need great public pressure on those who hold responsibility. Pure rational appeals prove very rarely successful, and this is because this conflict is about a lot of money and concrete interest. (Initiative *Gendreck weg!*)

We should notice that there are different views on the reach of public participation in science. Some advocate the need for CSO experts to be accepted and recognised by the scientific community. Others hold that it is necessary to distinguish a political dimension from technical problems (which should be dealt with by experts only):

> Concerning genetic engineering in the field of agriculture but also concerning other techniques, risk appraisal and engineering assessment are the job of the scientists. Nobody else can do that, no NGO; nobody besides scientists can do it. But when it is about evaluating those techniques, the population is demanded. Here awareness training is needed. (*Verband katholisches Landvolk*)

The interviews reveal awareness that architecting effective participation is in practice much more difficult than its advocates normally suggest. Good intentions are not enough to guarantee the expected outcomes in terms of bringing citizens closer to institutions and favouring citizens' inputs. The history of relative success and failure of the German experience has shown that 'more participation' is not the actual problem faced both by institutions and CSOs. The dominant question is rather, 'What participation?' How can the various stakeholders actually come together? Given their differences in knowledge, interests and resources, how should they channel the inputs coming from the various actors?

> What is also important is that the actual stakeholders come together. Those who are actually standing in the laboratory, those who conduct this process in practice and those who decide about the findings as well as those who afterwards give or deny authorization for this or that product, and of course the population, that

> numerically amounts to the most important part. I think the question how of they get together, this is at the moment the concrete obstacle. (*Kultursaat*)

In Germany, these 'concrete obstacles' have been experienced in almost 20 years of participation in the field of GMOs. How such obstacles can be overcome is no longer perceived as a matter of refinement of structured participatory procedures, but rather as a question of addressing the fundamental problems of inequality of material resources among the various actors involved and of transparency of the interests at stake in science policy.

The role of civil society organisations in the Spanish debate

Spain is the third largest maize producer in the European Union and is the only EU country in which large-scale commercial production of GM crops has been set up so far. Monitoring of *Bacillus thuringiensis*[4] maize crops by several research institutes and universities has been carried out since the first season they were cultivated, as a result of an agreement with the Ministry of the Environment and because it was a condition of the market approval. The sizeable proportion of GMO cultivations in Spain and the relatively weak anti-GMO movement, which is reflected by the high percentage of public acceptance of GMOs (77% as of 2007), has been recently associated to the small numbers of protected designation of origin products and of small farms, as well as to the recent modernisation of agriculture, which encouraged a significant portion of farmers to embrace GMOs cultivation (Kurzer and Cooper, 2007).

The current regulatory regime was approved by the centre-right (PP) government in 2003. In the case of cultivation of GMOs for uses other than commercialisation — for instance, research in confined and protected environments — potential users have a duty to inform the regional authority (*Comunidad Autonoma*). In cases when cultivation may cause the dispersion of the products in the environment, the potential users need to apply to the regional authority for a specific authorisation. In exceptional cases the regional authority may ask the consultative opinion of the Inter-ministerial Council on GMOs (CIOMG), which is the competent national authority for GMO authorisation. Concerning the commercialisation of GM products, authorisation should be requested from the CIOMG, which consults the *national biosafety commission* (CNB) for a technical report. The CNB is a consultative body, whose opinion is a non-binding requirement of the authorisation procedure. It is composed of representatives of several ministries, representatives of affected autonomous communities, and government appointed experts. After authorisation, GM crops are usually monitored in studies for coexistence, which report to the National Commission of Bio-vigilance (CNBv). Though similar to the CNB, the CNBv includes representatives of the economic sectors involved, of farmers organisations, and one CSO (Greenpeace).

The current monitoring system in Spain offers several opportunities to biotech corporations to voice their interests and opinions, while it proves almost impenetrable to civil society organisations

Hence, consultation with the public and CSOs is not contemplated at any time before authorisation and may actually occur only after authorisation has been granted in the context of the CNBv review. Moreover, the current monitoring system offers several opportunities to biotech corporations to voice their interests and opinions, while it proves almost impenetrable to CSOs. While Todt (2003) argues that Spanish risk assessment procedure, though not in a participative way, implicitly takes into account several concerns voiced by non-governmental organisations, CSOs find that their concerns are hardly taken into consideration. For these reasons CSOs in pain have preferred addressing the public directly.

Despite CSOs efforts, the public debate on GMO-related issues has not been as intense in Spain as elsewhere in Europe. At the beginning of the GMO implementation in 1998, decision-makers released few public statements on the issue, and the media paid little attention to the cultivation and commercialisation of a variety of GM maize, patented by Syngenta as 'Compa Maize'. As elsewhere in Europe, public opinion began to be more alert in 1999 when several magazines and some media began to address the issue in greater detail. Unlike other European countries, however, the attention on GMOs faded rather soon, and almost disappeared from both media coverage and public political debates after the year 2000.

Yet, during its most vibrant period, the debate was characterised by a harsh confrontation between two main accounts relating to precaution: regulatory bodies promoted a case-by-case approach to 'caution'; by contrast GMOs and farmers opposing GMOs favoured a systemic interpretation of 'precaution' (Todt and Luján, 2000). The *cautionary* approach does not consider GMOs as a special technology carrying a peculiar level of risk and/or requiring specific safety measures, but frames the issue of coexistence merely in terms of economic

profitability, farmer choice and label maintenance. The *precautionary* approach focuses instead on food safety, environmental protection, biodiversity and economic sustainability; it questions the agricultural system of production as a whole and insists on a holistic approach to the topic, rather than on a case-to-case problem-solving approach.

As to human food safety, CSOs make an important distinction between research and commercialisation:

> While we oppose GMOs' release in the environment, we accept that basic research should keep going on as long as it is carried out in totally isolated places, with no interaction with the environment. (*EHNE*)

Additionally, CSOs emphasise the importance of labeling in order to empower citizens and consumers. The main idea behind this position is the belief in consumer choice, which constitutes their basic principle for GMOs regulation:

> Another goal we pursue is that consumers may become reluctant to buy genetically modified products and or that they may at least become more demanding in requiring proper and detailed information about these products before buying them. (*OCUC*)

Finally, the debate has been focusing on the issue of the concrete risk that GM crops constitute for the preservation of biodiversity, and for the possible social conflicts among farmers that the diffusion of GM cultivations may provoke:

> Genetic modifications may reduce, in fact will reduce, the genetic heritage and, thus, local varieties and the overall biodiversity. With time, this may generate problems of new allergies or resistance to diseases that today are not problematic. (*AVACU*)

In spite of the historical absence of participatory practices, or perhaps just because of this, Spanish CSOs have displayed an overall positive and co-operative attitude towards the prospective introduction of participatory schemes. When they had a chance to suggest concrete measures to implement participatory schemes, however, the emerging vision of participation in science was strikingly different from current participatory practices.

First of all, CSOs consider feasible the idea of producing their own studies of evaluation and research on the GMOs at stake, provided that they are given time and appropriate financial resources:

> If you really want the participation of civil society actors in the research process, you really have to provide for a real participation since the beginning of the project … you have to acknowledge that you need a monitoring council, a committee or a working group. This requires time and resources that you have to include in the very budget proposal of the projects. (*SEAE*)

Second, confirming the analysis made by Barcena (2005), CSOs keep considering the connection between the scientific community, the biotech multinational corporations and the political actors — one of the main obstacles preventing a more open, participative dialogue between the scientific community and civil society organisations:

> In the *Comisión de Biovigilancia*, we invited the scientific members to make a public statement in which they were expected to declare that they had no link with the biotech industry. Unfortunately, none of them accepted to make such a declaration. (Greenpeace)

Third, CSOs stated that there is a general lack of transparency affecting both quantity and quality of public information on the implications of GMOs, which eventually discourages public awareness and prevents any serious public debate. In contrast, the CSOs insisted on the promotion of a real and inclusive public debate in order to reach consensus:

> To make sure that any participation in science can be effective it is absolutely necessary to have adequate access to information, especially when we deal with research projects related to agro-biotechnology. It would be interesting if civil society organizations could get to know more about these projects, given that the results have an impact directly on the citizens. In addition, in organizations like ours there are technicians and experts who may well contribute with their vision. (*OCUC*)

Yet, CSOs insisted that participation in science is a complex issue, which cannot be simply addressed by adding more representatives from CSOs. It is necessary to broaden the debate, so far excessively focused on technical issues, to include social and political aspects, consequences and repercussions of GMOs' development and commercialisation:

> The regulatory process is crucial and should not only take into account technical aspects but also all the most important social aspects implied, which can be achieved only through the participation of all the actors involved. For instance, the introduction of GMOs has produced a situation in which some farmers oppose other farmers; now this is a social issue rather than a technical one and nonetheless quite relevant. (*Amigos de la Tierra*)

Finally, CSOs ask to be involved at all times in the research process, from the debate on research

priorities and funds to the final approval and regulation of product for commercialisation:

> Participation should always occur at the early stages of research plans, in order to analyse the problems and to establish what is useful to be researched in the national research programs: It is necessary to define together what the most urgent problems are so that the scientific research may tackle them. (*AVACU*)

This has been elsewhere described as upstream participation (Wilsdon and Willis, 2004).

CSOs also suggest broadening the set of criteria to assess the viability of GMO development and commercialisation. The economic criteria, usually narrowly focused on economic benefits, neglect what should always be considered the main criterion: the public good. Technical and scientific safety and economic gains are necessary but not sufficient conditions to grant support for GMOs. Not only do CSOs argue that current debates, based merely on the scientific evidences provided by the GMOs producers, are unacceptable; they also suggest that it has become necessary to fund independent studies to make sure that the debate may eventually be balanced and reliable:

> It is incredible that in order to obtain authorizations for the commercial release of GMOs the evidence provided by the same companies that applied for authorization is usually sufficient ... It is crucial that all the authorizations granted to new technologies should be based on research studies that are thoroughly independent of any economic interest. (*Amigos de la Tierra*)

Although generally critical about current modes and processes of participation, CSOs not only emphasised the importance of civil society participation in research, but also constructively proposed some guidelines for a regulation process that is at once democratic and participative. Their attitude may well be summarised by the definition of participative science formulated by the representative of the association *SEAE*:

> Participative science occurs when also the final users of the scientific and technological products at stake are involved in the relative research process, from the beginning to the final release on the market.

Yet, while sharing similar perspectives on participation, CSOs present relevant differences. Consumer associations, for instance, emphasise labeling and traceability as important devices to enable a regulatory system based on consumer choice. In contrast, environmental associations insist that GMOs constitute a collective threat to both human safety and natural biodiversity and, therefore, advocate collective actions based on public regulations and monitoring. Organic farmers share such a collective approach to GMOs and biodiversity, but insist that no successful management of GMOs can ever take place unless the economic issues of competition and monopoly are taken into consideration.

In sum, the Spanish case is in many ways peculiar within the EU. On the one hand, it is the country with the largest GM crops in Europe, with a portion of cultivated land that approaches 50,000 acres. The government has always shown a very technocratic attitude, usually accompanied by deep skepticism about participatory schemes. On the other hand, it is the country where CSOs, though critical of current participatory technology assessment practices, revealed a very constructive and collaborative attitude towards the possibility of improving participatory practices and initiatives, with an emphasis on upstream participation.

Lessons from Spain and Germany

There are two main lessons to be learned from our qualitative study, one from the difference between the two countries, and one from the similarities emerging from the interviews.

Especially on the GMO issue, Germany and Spain present two very different experiences of public participation in science. Germany's deliberative tradition makes institutions very prone to accept, and indeed foster, participatory exercises. Additionally, the political climate under the red–green governments (1998–2005) was indeed favourable to the environmentalist cause. This notwithstanding, the outcomes in terms of participation were rather disappointing for CSOs and institutions alike (Torgersen and Bogner, 2005; Toft, 2005). Frustration, cynicism and impatience with institutionalised participatory strategies emerge from the interviews. The 'structural coupling' between law and science, and the restriction of the debate to scientific and technical questions framed by the institutions are normally identified as the main problems.

Alfons Bora (2005) argues that the synergy between science and law has produced a techno-scientific normative system that rigidly defines the legitimate objects of discussion, the specific definition of risk, and carries the legitimate images of the 'others' and of 'society' congruent with the scientific view. As a consequence, legal norms can be criticised only through legal rationality, and scientific norms through scientific rationality. Outside these rigid structures and rules, participation simply is either not allowed or it is given no legitimacy.

The interviews confirm this view of institutional participation, and German CSOs prefer to think of participation in science in more radical ways — which address the very goals of science (innovation versus public good; biotechnology versus organic

farming) — and do not especially welcome new opportunities of participating in decision-making concerning specific technical questions.

In Spain, the depoliticisation of the GMO debate has led CSOs to engage mainly in public campaigns to address the population directly. Paradoxically, excluded from the formal decision-making processes, Spanish CSOs are more optimistic about the possibility of opening up these processes to input from 'below'. Although deeply critical of the technocratic approach in Spanish science policy, they offer concrete proposals of how effective participation can be organised to reach effective dialogue, emphasising upstream participation and the need for alternative scientific priorities and directions, mainly in support of organic agriculture. Their ultimate goal is to set a new, and more participative, science system pursuing the common good, rather than the mere increase of knowledge and of economic growth. Their highest priority always goes to the promotion of public debates around science policy, of consumer awareness, and of alternative agricultural and consumption models. Free from the conditions exercised by previous participatory experiences, Spanish CSOs are even moderately optimistic about 'institutional participation' in science policy, especially when their answers are compared with those of German CSOs.

A result of our analysis, therefore, is that participation does not always increase mutual learning, understanding, or trust, nor does participation necessarily imply better democracy. This seems to corroborate and put into context the observations made for example by the European Comission that:

> If done disingenuously, engagement runs the risk of manipulating public, which is worse than ignoring them. (EC, 2007: 25)

A second and perhaps more important lesson comes instead from the similarities found in the answers in the two countries. Despite their radically different experiences, there is a remarkable convergence in the perspective of Spanish and German CSOs on what are the main problems of participation in science. This convergence, emerging from the interviews, can be articulated around the following points.

A result of our analysis, therefore, is that participation does not always increase mutual learning, understanding, or trust, nor does participation necessarily imply better democracy

- Science behind closed doors is dangerous. By contrast, increasing transparency of the research objectives and of the science policy agenda is a way to expose science to public scrutiny but also to enhance public debate and solicit input from the people and from specialised CSOs.
- Participation can have little meaning if research depends on the sponsoring of industry and if debates are centered merely on technical discussion: industry can always have access to most qualified experts and prevail argumentatively.
- CSOs call for a closer cooperation with scientific and industrial actors, suggesting that meaningful participation in regulatory stages of science and innovation processes can occur only if civil society has been on board ever since the agenda-setting stage opened. When innovation is the result of a shared path, it also involves shared responsibility. Although the consensus on this point emerging from the interviews is quite wide, whether it is appropriate to call for a stronger responsibility of the lay public (rather than public institutions or industrial actors) would require a deeper analysis, which is, however, beyond the scope of this paper.
- Initiatives that come from lay people and associations (information campaigns, forums) are important to initiate debates on issues that would not otherwise be considered in more institutionalised settings, and ensure that a broader range of experience is drawn upon in shaping scientific priorities and innovation processes.

On a more general level, CSOs tend to approach the current systems of science and technology innovation as deeply embedded in specific social contexts, which they see as profoundly affected by dynamics of cooperation and power struggles that closely involve industry, academics and policy-makers but consistently exclude other social actors. Although their goals may substantially differ, depending on their nature, mission and historical trajectory, CSOs believe they can make important contributions towards the formulation of public interest by offering alternative approaches to scientific questions and by providing important insights on the social impact of new technologies.

All these elements can be meaningfully taken into account only if participation in conceived starting from the *co-production* perspective presented in the section headed 'Democratisation of expertise and the co-production of science' above. In Spain and Germany, CSOs have an understanding of participation, both in terms of goals and means, that substantially differs from the prevailing institutional perspectives in the two countries (technocracy in Spain and democratisation of expertise in Germany).

From our analysis it emerges that CSOs interpret participation in a much broader sense than other institutional actors normally do. In particular, CSOs argue that participation cannot be restricted either to regulatory back-end practices or to risk-based

analysis. Instead they emphasise the importance of the processes external to the deliberative *fora* organised by government. They keep the main focus on practices and discourses that are prior to these organised deliberative contexts and can be useful to give shape to these deliberative exercises. Participation in science, in the co-production approach that corresponds to the view of several CSOs, makes sense only when science is understood as a societal enterprise rather than as a technological process of expanding expertise in support of economic growth. As David Sarewitz (2006: 105) has put it:

> The most positive role for science comes only after values are clarified through political debate and after values for the future are agreed through democratic means.

Our task in this article has been limited to explaining how we can better understand CSOs' expectations, and to account for their perceptions of the problems associated with existing institutional practices of participation in science. We believe that the results of our analysis provide valuable information to understand what has failed so far with many participatory exercises. However, we did not address the question of how this information, in more practical terms, can help policy institutions to improve the terms of their engagement with CSOs. If *democratising expertise* recommends bringing democracy in science committees, from a *co-production* perspective all societal actors involved in the wider process of science production, diffusion and consumption are invited to reconsider critically the mutually constitutive relationship between emerging forms of knowledge production and social order (Felt *et al*, 2007).

Translating this into some practical recommendations is a highly demanding task, insofar as participatory science governance points to a radical 'change of mentality' (De Marchi, 2003) and perspective rather than simply to the elaboration of new institutional participatory schemes. Indeed recently some political istitution seem to have accepted this challenge. At least at EC level, there is an awareness that participation implies promoting, along with dialogue, 'upstream engagement' that can open up to questioning 'values, visions and vested interests that motivate scientific endeavour' (EC, 2007: 16). Significatively, the EC Report on Public Engagement in Science (2007) suggests the need to 'renew the social contract for science' (EC, 2007: 9).

From a co-production perspective, all concerned actors are urged to engage actively not only in the context of existing participatory practices but also in the context of existing and emerging processes of knowledge production. This means promoting a new culture of democratic governance, in which asymmetries of power, master narratives and imaginaries, sources of information, social processes of identity-making and social and economically sustainable trajectories of development may all come explicitly to the fore and be subjected to public scrutiny. This should occur not only along *all the stages* of current institutional settings of science production but also *outside them*, across the variety of uninvited participatory practices emerging as a result of organised public and CSOs' actions.

Though this may appear challenging, there seems to be a certain convergence between the expectations of CSOs emerging from the interviews and the programmatic work of some regulative institutions (e.g. EC, 2007) which emphasise, among other things, upstream engagement and uninvited participation. This is an indication that new developments in participation approaches, at least at European level, not only seem to be more fitting to the demands of civil society, but also may open up a virtuous circle of debate, dialogue and cooperation also in the different member states.

Appendix 1. List of the 32 civil society organisations interviewed

Germany	**Spain**
AbL Arbeitsgemeinschaft bäuerliche Landwirtschaft e.V.	*Red de Semillas*
Agrarbündnis e.V.	*SEAE (Sociedad Espanola de Cultura Ecologica)*
Biokreis e.V.Verband für ökologischen landbau und gesunde Ernährung	*AVACU (Asociacion Valenciana de Consumidorey y Usuarios)*
BioSicherheit - Gentechnik, Pflanzen, Umwelt	*Greenpeace España*
BUND für Umwelt und Natursh utz Deutschland - Freunde der Erde	*Associació TARRACO*
Deutscher Frauenring e.V.	*EHNE Pais Vasco (Euskal Herriko Nekazarien Elkartasuna) is a professional agrarian organisation*
Evangelisches Bauernwerk in Badem Württemberg e.V.	*COAG (Coordinadora de Organisaciones de Agricultores y Ganaderos)*
Gendreck weg! Freiwillige Feldbefreiung	*OCUC Cataluña (Organisacion de Consumidores y Usuarios de Cataluna)*
Gentechnikfreie Landwirtschaft NRW	*Asociación Vida Sana*
Gentechnikfreie Nachbarschaft Münster-Kasewinkel	*FACUA Andalucía (Federacion de Asociaciones de Consumidores y Usuarios de Andalucia)*

(*continued*)

Appendix 1. (*continued*)

Germany	**Spain**
Informationsdienst Gentechnik, c/o Zs-L Zukunftsstiftung Landwirtschaft	*Amigos de la Tierra*
Kein Patent auf Leben	*GRAIN (http://www.grain.org/about/)*
Kultursaat e.V.	*Ecologistas en Accion*
n-a-h-r-u-n-g-s-k-e-t-t-e – (Verbraucher- und Umweltinitiative für sichere und gesunde LEBENsmittel)	
NABU (Naturschutzbund Deutschland, Bundesgeschäftsstelle Bonn)	
refo - Bundesverband Deutscher Reformhäuser e.V.	
Verband katholisches Landvolk e.V.	
Verbraucherzentrale Bremen e.V.	
Zukunftsstiftung Landwirtschaft	

Note: Some of the interviewees want to remain anonymous

Acknowledgments

We wish to thank Elvira Santiago, Juliane Klein and Viktoria Ackhurina for their assistance in the empirical work in this article. Thanks also to Jens Steffek and Sara Degli Esposti for useful comments. The financial support of the DG Research of the European Commission (Project PSx2: contract 044594 SAS6) is gratefully acknowledged. The team of PSx2 has provided very important insight and discussion on the article topic, and so have the participants at the research seminar at CSIC (Madrid) and at the Max Plank Institute in Heidelberg in which we presented an earlier version of this paper.

Notes

1. While in Germany public debate on GMOs regulation almost followed the development of the technology step by step, in Spain the introduction of GMOs cultivation occurred in the absence of any public debate and with the explicit support and commitment of the ruling political elite of the time (Todt and Luján, 2000).
2. The term 'civil society' has become a key phrase in the EU. In one of the current uses, 'civil society' designates non-governmental and non-economic actors (such as NGOs, voluntary associations, social movements, families and religious groups) that interact to give rise to a political public sphere by which governments and institutions are linked to the life of people (Benhabib, 1996: Dryzek, 2000). The definition of CSOs that we adopt follows the criteria established by the European Commission: 'They are not profit, formed voluntarily, independent (of government/public authorities, political parties or commercial organisations), they aim to act in the public arena at large, on concerns and issues related to the well being of people, specific groups or society as a whole (EC, 2006).
3. This participatory strategy was designed by a research institution and accompanied by sociological research and evaluation, to investigate to what extent conflicts over biotechnology could be solved through a discursive process based on scientific and technical argumentation and where the process should be controlled by the participants themselves, with no external arbiter (Van den Daele, 1995).
4. Bt maize is a variety of corn that has been genetically modified to resist herbicides and produce the *Bacillus thuringiensis* toxin, which protects the plants from pests and insects.

References

Abels, G 2007. Citizen involvement in public policy-making: does it improve democratic legitimacy and accountability? The case of PTA. *Interdisciplinary Information Sciences*, **13**(1), 103–117.

Barcena, I 2005. European governance and green social movements: transportation and GMO policies in Spain. *Human Ecology Review*, **12**(2), 120–132.

Bauer, M W and G Gaskell 2002. *Biotechnology: the Making of a Controversy*. Cambridge: Cambridge University Press.

Benhabib, S ed. 1996. *Democracy and Difference: Contesting Boundaries of the Political*. Princeton, NJ: Princeton University Press.

Bernauer, T 2003. *Genes, Trade and Regulation: the Seeds of Conflict in Food Biotechnology*. Princeton, NJ: Princeton University Press.

Bora, A 2005. Biopolitics, citizenship, and the 'iron cage' of law. Discussion Paper, Workshop 'Normativities', Bielefeld, 7–9 July.

Bora, A and H Hauseldorf 2006. Participatory science governance revisited: normative expectations versus empirical evidence. *Science and Public Policy*, **33**(7), August, 478–488.

Bora, A and W van den Daele 1997. Partizipatorische Technikfolgenabschätzung. Das Verfahren des Wissenschaftszentrum Berlin zu transgenen herbizidresistenten Kulturpflanzen. In *Diskursive Verständigung? Mediation und Partizipation in Technikkontroversen*, eds. S Köberle, F Gloede and L Hennen, pp.124–150. Baden-Baden: Nomos.

Borras, S 2006. Legitimate governance of risk at the EU level? The case of genetically modified organisms. *Technological Forecasting and Social Change*, **73**, 61–75.

Börzel, T 1997. What's so special about policy networks? An exploration of the concept and its usefulness in studying European governance. *European Integration Online Papers (EIoP)*, **16**(1), 25 August.

Brendle, U and C Hey 1992. Umweltverbände im internationalen Vergleich. *Wechselwirkung*, **55**, 6–11.

Carolan, M S 2008. Democratising knowledge – sustainable and conventional agricultural field days as divergent democratic forms. *Science, Technology and Human Values*, **33**(4), 508–528.

De Marchi, B 2003. Public participation and risk governance. *Science and Public Policy*, **30**(3), June, 171–176**.**

Doyle, C and P Patel 2008. Civil society organization and global health governance: challenges to legitimacy. *Social Science and Medicine*, **66**(9), May, 1928–1938.

Dryzek, J 2000. *Deliberative Democracy and Beyond: Liberals, Critics, Contestations.* Oxford: Oxford University Press.

EC 2001. Democratising expertise and establishing scientific reference systems. *European Commission Document of 2 July 2001. Working Group 1B*. Available at: <http://europa.eu.int/comm/governance/areas/ index_en.htm>, last accessed 25 January 2006.

EC 2006. The state of play of civil dialogue in DG RTD. Available at: <http://ec.europa.eu/research/science-society/document_library/pdf_06/civil_dialogue-state_of_play_en.pdf>, last accessed 25 January 2009.

EC 2007. Public engagement in science – report of the science and society session. Lisbon Presidency of the EU, Brussels. Available at: <http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=781&CFID=3681619&CFTOKEN=f2f7058264bfd389-F6F2EB97-BDDC-4BB7-

C90E189080D78586>, last accessed 21 January 2009.
Ellis, R and C Waterton 2004. Environmental citizenship in the making: the participation of volunteer naturalists in UK biological recording and biodiversity policy. *Science and Public Policy*, **31**(2), April, 95–105.
Evans, R and A Plows 2007. Listening without prejudice? Rediscovering the value of the disinterested citizen. *Social Studies of Science*, **37**(6), 827–854.
Felt, U *et al*. 2007. Taking European knowledge society seriously. European Commission Working Document, EU Brussels.
Ferretti, M P 2007. Why public participation in risk regulation? The case of authorising GMO products in the European Union. *Science as Culture*, **16**(4), 377–395.
Funtowicz, S and J R Ravetz 1992. Three types of risk assessment and the emergence of post-normal science. In *Social Theories of Risk*, eds. S Krimsky and D Goding, pp. 251–274. Westport: Praeger.
Gill, B 1993. Technology assessment in Germany's biotechnology debate. *Science as Culture*, **4**(1), 69–84.
Gottweis, H 1998. *Governing Molecules: the Discursive Politics of Genetic Engineering in Europe and the United States*. Boston: MIT Press.
Greenwood, J 1997. *Representing Interests in European Unions*. Basingstoke: Macmillan.
Hammerbacher, R 2003. *Diskurs Grüne Gentechnik. Abschlussbericht der Moderation*. Hammerbacher Gmbh, Osnabrück. Available at <www.gruene-gentechnik.de/dgg/dokumente/abschlussbericht>, last accessed 20 September 2008.
Hampel, J *et al* 1998. *Germany in Biotechnology in the Public Sphere: a European Sourcebook*, eds. J Durant, M W Bauer and G Gaskell, pp. 63–77. NMSI Trading Ltd.
Hansen, J 2006. Operationalizing the public in participatory technology assessment: a framework for comparison applied to three cases. *Science and Public Policy*, **33**(8), October, 571–584.
Irwin, A and B Wynne eds. 1996. *Misunderstanding Science? The Public Reconstruction of Science and Technology.* Cambridge: Cambridge University Press.
Jasanoff, S 1996. Beyond epistemology: relativism and engagement in the politics of science. *Social Studies of Science*, **26**(2), 393–418.
Jasanoff, S 2003. Technology of humility: citizen participation in governing science. *Minerva*, **41**, 223–244.
Jasanoff, S ed. 2004. *States of Knowledge: the Co-production of Science and Social Order*. London and New York: Routledge.
Joerges, C and J Neyer 2003. Politics, risk management, World Trade Organisation governance and the limits of legalisation. *Science and Public Policy*, **30**(3), June, 219–225.
Katzestein, P J 1987. *Policy and Politics in West Germany: the Growth of a Semi-Sovereign State.* Philadelphia: Temple University Press.
Kerr, A *et al* 1997. The new genetics professional discursive boundaries. *Sociological Review*, **45**(2), 279–303.
Kurzer, P and A Cooper 2007. 'What's for dinner?' European farming and food traditions confront American biotechnology. *Comparative Political Studies*; **40**, 1035–1059.
Levidow, L 2007. European public participation as risk governance: enhancing democratic accountability for AgBiotech policy. *Technology and Society*, **1**, 19–51.
Levidow, L, S Carr and D Wield 2005. European Union regulation of agro-biotechnology: precautionary links between science, expertise and policy. *Science and Public Policy*, **32**(4), August, 261–276.
Liberatore, A and S Funtowicz 2003. Democratizing expertise, expertizing democracy: what does it mean, and why bother? *Science and Public Policy*, **30**(3), June, 146–150.
Macnaghten, P *et al* 2005. Nanotechnology, governance and public deliberation: what role for the social sciences? *Science Communication*, **27**, 268–291.
Marris, C *et al* 2001. *Final Report on Public Attitudes to Biotechnology in Europe*. Research project funded by the ECC, Contract n. FAIR CT 98-3844.
Martello, M L 2004. Global change science and the Arctic citizen. *Science and Public Policy*, **31**(2), April, 107–115.
Mayer, S 2003. Science out of step with the public: the need for public accountability of science in the UK. *Science and Public Policy*, **30**(3), June, 177–181.
NHI, National Institute for Health 1998. *Scientific Opportunities and Public Needs*. Available at: <http://www.iom.edu/CMS/3740/5682.aspx>, last accessed 20 September 2008.
Nowotny, H 2003. Democratising expertise and socially robust knowledge. *Science and Public Policy*, **30**(3), June, 151–156.
Pellizzoni, L 2001. The myth of the best argument: power, deliberation and reason. *British Journal of Sociology*, **52**(1), 59–86.
Rothstein, H 2004. Precautionary bans or sacrificial lambs? Participative risk regulation and the reform of the UK Food Safety Regime. *Public Administration*, **82**(4), 857–881.
Rowe, G *et al* 2008. Analysis of a normative framework for evaluating public engagement exercises: reliability, validity and limitations. *Public Understanding of Science*, **17**, 419–441.
Sarewitz, D 2006. Liberating science from politics. *American Scientist*, **94**, 104–106.
Skorupinski, B and K Ott 2000. *Technikfolgenabschätzung und Ethik. Eine Verhältnisbestimmung in Theorie und Praxis*. Zürich: vdf.
Steffek, J *et al* 2007. *Civil Society Participation in European and Global Governace*. New York: Palgrave.
Stirling, A 2006. Analysis, participation and power: justification and closure in participatory multi-criteria analysis. *Land Use Policy*, **23**, 95–107.
Thoyer, S and B Martimor-Asso 2007. *Participation for Sustainability in Trade.* Aldershot: Ashgate Publishing.
Todt, O 1999. Social decision making on technology and the environment in Spain. *Technology and Society*, **21**, 201–216.
Todt, O 2003. Designing trust. *Futures*, **35**, 239–251.
Todt, O and J L Luján 2000. Spain: commercialization drives public debate and precaution. *Journal of Risk Research*, **3**(3), 237–245.
Toft, J 2005. Denmark's regulation of agro-biotechnology: co-existence bypassing risk issues. *Science and Public Policy*, **32**(4), August, 293–300.
Torgersen, H and A Bogner 2005. Austria biotechnology regulation: political consensus despite divergent concepts of precaution. *Science and Public Policy*, **32**(4), August, 277–284.
Van den Daele, W 1995. Technology assessment as a political experiment. In *Contested Technology: Ethics, Risk and Public Debate*, ed. R von Schomberg, pp. 63–89. Tilburg: International Centre for Human and Public Affairs.
Weingart, P 1999. Scientific expertise and political accountability: paradoxes of science in politics. *Science and Public Policy*, **26**(3), June, 151–161.
Wilsdon, D and R Willis 2004. *See-through Science: Why Public Engagement Needs to Move Upstream*. London: Demos.
Wynne, B 2002. Risk and environment as legitimatory discourses of technology: reflexivity inside out? *Current Sociology*, **50**(3), 459–477.
Wynne, B 2006. Public engagement as a means of restoring public trust in science – hitting the notes, but missing the music? *Community Genetics*, **9**, 211–220.