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## **Critical Systems Heuristics: a tool for the inclusion of ethics and values in complex policy decisions**

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Drawing on a study of members of the UK's Agriculture and Biotechnology Commission, this paper explores the use of Critical Systems Heuristics (CSH) as a structured approach to the inclusion of ethics and values in complex policy decisions.

CSH was devised by Ulrich in a planning context, as a way of making explicit the value assumptions underlying practical judgements by means of critical reflection. It is rooted in Critical Systems Thinking, which challenged earlier notions of systems thinking by introducing a more socially aware and critical form of systems practice.

Ulrich used the concept of system boundaries to provide a conceptual framework for dealing with the facts and values that underlie a decision. The CSH framework encourages people to consider critically such matters as what counts as an ethically-defendable 'improvement', who should benefit, and what should count as relevant knowledge and sources of expertise.

This paper highlights some of the advantages and disadvantages of CSH as a tool for achieving a more inclusive, critical and self-reflective approach to decision making about genetically modified crops.

### **1 Background**

Policy decisions surrounding the commercialisation of GM crops are complex and controversial. Although the European Commission has granted approval for several types of GM crops to be grown commercially throughout the European Union, there are objections from some member states, opposition from many NGOs and concern and resistance among the general public.

In the UK, Government has responded to opposition and concern with three main initiatives. It has funded large-scale farmer-managed trials of approved GM crops. It has agreed with industry a phased introduction or 'managed development' of commercial crops. It has extended the range of expertise included in its advisory body ACRE (Advisory Committee on Releases to the Environment) and has established a new body, the AEBC (Agriculture and Environment Biotechnology Commission), to advise it on the more strategic issues and issues of concern to the public. More recently (July 2002), in response to AEBC's advice, it has initiated a public dialogue, involving three supposedly interactive strands: a formal public debate, a science review and an economics study.

Although the UK Government's initiatives go some way towards addressing the concerns that have been expressed by various groups and individuals, there are still criticisms that they do not go far enough. In particular, some researchers have pointed out that the general public's concerns are as much about the *process* of decision-making, and about the value and social assumptions involved, as about specific risks of biotechnology and its applications. For example, Grove-White et al (1997) found that people felt a sense of being 'left in the dark', but that what they wanted was not technical information but information that 'convinces me genuinely that I can trust the judgement and vision of the people and procedures governing decisions taken on my behalf'.

Similar findings were reported in an EU study, which urged the need for a debate about the purposes and social visions driving and shaping research and innovation, as part of an accountable decision-making process. (PABE)

Other criticisms of the GM decision-making process are that:

- It draws a narrow boundary round the issues considered to be relevant
- It is not sufficiently inclusive – participation is limited
- It is not self-critical and reflexive
- It deals separately with scientific and ethical issues, and has no clear process for integrating them
- The value basis of judgements is taken for granted and not open to scrutiny.

This paper discusses an approach called Critical Systems Heuristics that we believe might help to address some of these criticisms of the GM decision making process. Section 2 describes the theoretical basis of this approach. Section 3 describes how we used it in a study of the UK's Agriculture and Environment Biotechnology Commission. Section 4 provides a summary of our results. Section 5 discusses the strengths and weaknesses of the approach (and our use of it) and suggests how it might be developed further. Previous discussions of our tests of this approach can be found in Carr and Levidow (2000) and Carr and Oreszczyn (2001).

## 2 The theoretical basis

Critical Systems Heuristics is a name applied by Ulrich to a set of 12 questions he devised to encourage critical thinking about the value judgements that underlie planning decisions (Ulrich, 1993; 1996). The questions do this by examining the limits or boundaries of decisions, for example, which groups of people and types of information have been considered relevant to the decision and which have been considered irrelevant and thus excluded or marginalised.

Ulrich's purpose was to find a way of counteracting what he described as the monopoly of knowledge and power accorded to experts and institutionalised science to the exclusion of ordinary people. Although Ulrich talks about planning decisions, he intends the term planning to include other kinds of social intervention, including policy decisions. His questions are based on three key ideas. The first is that, if the aim of such decisions is to bring about improvement, then since improvement is a subjective concept, the decision-makers' view of improvement should be subjected to challenge to test its worth in the light of other viewpoints and other value systems. The second is a related point – that the participation of a variety of stakeholders is important because different stakeholders may bring different insights to bear on the decision. The third is that the boundaries of the system – the people and information considered relevant to the decision – are socially constructed. Different values might lead to different people and factors being considered relevant, that is, to a different system boundary.

In thinking through his ideas on 'boundary critique', Ulrich drew particularly on the work of Churchman (1971, 1979) and Habermas (1976, 1984). Churchman suggested that in order to justify a change as an improvement, it is necessary to reflect on the boundaries of the analysis. He said that to allow the most inclusive view of improvement to emerge, as much information as possible should be considered. Churchman argued that the boundaries of the analysis or system are not 'givens' but are socially constructed. He proposed that in order to be sure we are defining improvement adequately, we should seek out 'enemies' of our ideas and engage in rational argument to see if they survive challenge. He called this a 'dialectical process'.

Ulrich, while agreeing with Churchman's views on inclusivity in theory, argued that for practical reasons limits, or boundaries, have to be set. However, people should be able to justify the boundaries they set by means of rational argument. Ulrich turned to Habermas for ideas about the nature of rationality. Habermas argued that rationality depends on dialogue. Its basis is open and free questioning between human beings. Since Habermas recognised that power can have a distorting effect on dialogue, he said that rationality depends on an 'ideal speech situation' – a situation where any assumption can be subject to critique and all viewpoints can be heard.

As in the case of Churchman's views on inclusivity, Ulrich considers that Habermas's 'ideal speech situation' is unattainable in practice. This led Ulrich to the view that a more practical aim is to combine critical inquiry (in which no assumption should be beyond question) with systems thinking (concerning the boundaries of the inquiry). He developed the set of questions he called 'Critical Systems Heuristics'

as guidelines for such a boundary critique. Ulrich considers that boundary critique is essentially an ethical process, since debates about who and what should be included inside the boundary of the system to be improved (as well as the understanding of 'improvement') depend on value judgements.

Ulrich's checklist of questions to guide boundary critique are summarised in Table 1. In devising the questions, Ulrich focussed on people and their social roles in the decision process, since it is people who determine what constitutes an improvement. He grouped the questions around four social roles, three of them concerning the people *involved* in the decision process and the fourth concerning people who are *affected* but not involved. Among those involved he included the *clients* (those who are the intended beneficiaries of the improvement), the *decision-takers* (those who have the say), and the *planners* (or experts, those who have the relevant know-how). He named the fourth social role the *witnesses* (those who act on behalf of the affected who bear the costs and/or side-effects).

For each social role, the first question is about who occupies (or should occupy) that role. The second question is about a key concern relating to that role and its contribution to the understanding of what counts as an improvement. So for the client (or beneficiary) role, the question is about the purpose of the improvement (how will the client benefit). For the decision-taker's role, the question is about what resources are under the decision-taker's control (how much control does the decision maker have over the resources needed to achieve the improvement). For the planner (or expert) role, the question is about what type of expertise and knowledge is relevant. For the witness role, the question is about the provisions made to protect or compensate the affected.

For each social role, there is a third question that draws attention to issues that can arise if there is conflict with other social actors about the key concern associated with that role. Ulrich says that the way such conflicts are handled contributes to the understanding of what is meant by 'improvement'. For the client role, this third question asks what is (or should be) the measure of improvement. For the decision-taker role, the question is about the resources beyond the decision taker's control. For the planner or expert role, the question is about the guarantee that the improvement will work out as the planner or expert intend. For the witness role, the question is about how the improvement takes into account differences in worldview, or different visions of 'improvement'.

### 3 Our approach

To test the relevance of the CSH framework to biotechnology, we used it as the basis of interviews with the members of the UK's Agriculture and Environment Biotechnology Commission (AEBC). The AEBC was established in June 2000 by the UK government in response to the crisis in public confidence over GM issues (ENDS Report, 2000). Its 20 members include both opponents and proponents of GM technology, as well as some who have not previously engaged with the issues. Its remit includes offering strategic advice to the government on biotechnology issues, keeping under review developments in biotechnology, and advising government on their ethical and social implications and public acceptability (AEBC, 2001: 10). As part of this process, the AEBC seeks to involve and consult stakeholders and the public on a regular basis.

We chose the AEBC as a clearly defined group of people, with well-informed views, who had been selected by government to cover a wide spread of expertise and opinions on GM issues. The membership includes scientists, farmers, public interest groups, lawyers and philosophers, as listed in Table 2. Only three members declined our request for an interview. We interviewed each member individually (and the government official who acts as the AEBC secretary), asking the checklist of 12 CSH questions. For each pair of questions we asked the 'ought' question before the 'is' question. We did this intuitively at first, but then more deliberately as we realised that the 'ought' questions were more open, encouraging people to reflect carefully on their own views, whereas the 'is' questions prompted a more restricted answer. Whenever there was time, we asked for feedback on the questions and talked more generally about the AEBC. Interviews were tape-recorded and we took notes as a back-up.

### 4 Results

Although people sometimes had difficulty with the way the questions were worded, they had no problem in relating them to the topic of biotechnology even though the questions were originally devised for a different context. Sometimes people asked for the question to be repeated or asked for

clarification. Scientists were less familiar than other people with some of the language. The main difficulty was that some people were uncomfortable in responding to the questions without a specific pre-defined context or 'system'. We tried to resist the temptation to provide prompts, because we wanted people to answer in terms of a system that was relevant to them. We encouraged people to respond in terms of the aspects of biotechnology with which they were most familiar. People mainly answered in relation to biotechnology in general, or gm crops. Two answered the questions in relation to the AEBC, one in relation to the biotechnology decision-making process, one in relation to the regulatory framework and one in relation to risk assessment.

A summary of the answers to each question is provided below. The summaries don't do justice to the richness of the answers and the thought that went into them. There were often long pauses as people tried to clarify and articulate their views.

*The client/beneficiary role (Qs 1-3)*

*Q1a) Who ought to be the client or beneficiary?* There was considerable agreement over the question of who ought to be the client or beneficiary. Most answers drew a wide boundary, referring to the consumer, the community at large, citizens, society, the general public. Even the most narrowly defined answer – the applicant for consent – was mentioned in the context of the application's value to society. One or two answers drew a very wide boundary, by including the global population, future generations, the agricultural/environmental relationship, and nature generally.

*Q1b) Who is the client or beneficiary?* In answer to the question 'who is the client or beneficiary', most people recognised that a much narrower boundary existed in practice. The beneficiaries were seen (or perceived by the public to be seen) as the developers, biotechnology companies and their shareholders, and the research community. One or two people also mentioned farmers. Some pointed out that it was a young industry, and that the situation was a dynamic and changing one. One or two mentioned that the public were not being served, that they felt out of control.

*Q2a) What ought to be the purpose?* No clear view emerged of the purpose. A scientist said 'I'm not sure that there is any ought in this at all', except that '...the ought is that we should allow progress to occur' since technology can be used for important and benign ends. One member said 'I don't think anyone really knows what the purpose of all these crops are' and suggested part of the reason for establishing the AEBC was to give people a chance to establish 'a more strategic wide-ranging view of where we might all be going – a sort of collective drawing of breath'. One answer concerned biotechnology's contribution to plant breeding. Several answers were linked to improving the sustainability of agriculture and reducing its environmental impact. Two people mentioned helping less developed countries. One person mentioned 'for the greater good of society' and another 'products to help meet people's needs better'.

*Q2b) What is the purpose?* Again, no clear sense of the purpose emerged. One reason given for this was that GM crops are not yet being grown commercially in the UK. Another reason given was that the regulatory framework operates on the basis that GM crops will be developed unless there's a risk, so there's no requirement to consider the purpose or benefits. Several people mentioned economic motives – for shareholders, companies, the economy in general. Two or three people referred to motives relating to industry: the consolidation of biotechnology companies with pesticide companies, increasing market share, allowing the agricultural industry to gain more control over all the players in the field, and (in relation to the decision making system) to facilitate industry's progress. One specific purpose mentioned in relation to GM crops was the more precise targeting of pests. In relation to the AEBC, one purpose mentioned was that of bringing the two conflicting sides in the debate together. In relation to GM risk assessment, one person mentioned the prevention of harm to the environment, but considered that harm was inadequately defined. Another mentioned that the purpose of risk assessment to protect health and environment neglects the way that people feel about GM technology.

*Q3a) What ought to be the measure of performance?* (That is to say, how should we judge the extent to which the purpose has been achieved?) This was generally seen as a complex and challenging question, with several people mentioning that there would need to be a range of criteria or indicators and that these would vary for different stakeholders and perspectives. Examples included: for farmers – higher yields, for companies – profits, for consumers – cheap food and intangibles such as feeling good about the food. Other indicators suggested were: the position of the UK in the global biotechnology market,

the number of individuals benefitting, the acceptance of products, the more efficient use of resources especially non-renewables. More general suggestions concerned the efficiency, sustainability, quality and environmental impact of food production and measures relating to the quality of life and the benefit to society. Two people said the measure should be that the benefits should outweigh any negative consequences. Talking specifically about biotechnology in relation to less developed countries, one person said the measure should be substantial improvements to the lot of the world's poor. Two measures were suggested specifically in relation to the purposes of the AEBC, one involving the monitoring of public knowledge about GM, the other based on the provision of clear statements to Government as an outcome of the AEBC's deliberations. Two people mentioned that it was difficult to specify measures because of gaps in our knowledge about possible consequences. One person suggested that a way forward was first to agree a generally desirable direction for change, then to monitor progress towards that change compared with conventional practice.

*Q3b) What is the measure of performance?* The main measure of performance at present was seen by several people as profitability, relevant mainly to companies, shareholders, growers and retailers. One person commented that people were led to believe this was the only measure by inaccurate reporting in the media. The only other existing measures mentioned were the position of the UK in the global biotechnology market, and physical impacts on the environment and health, although one person mentioned that the concept of 'safety' being used for this measure of environmental and health impacts was controversial. One person pointed out that the reason there is no measure is that GM crops are not yet being grown in the UK but that in the US the measures are ease of weed control, profitability, price, reduced environmental impact, reduced spraying and novel products. Most answers referred to the lack of existing measures of performance and to the difficulties of devising acceptable measures. People on the regulatory committees are striving to find answers to such questions for this new technology but as one person commented '*there is a long way to go*'.

#### *The decision-maker role (Qs 4-6)*

*Q4a) Who ought to be the decision maker?* Most people were clear that the elected government ought to be the decision maker, to balance societal and individual interests and to be accountable for the decision. In expanding on this answer, people described the type of on-going democratic consultation process they thought was needed to inform government's decision. For example, people thought that government should be aware of the full range of dimensions of concern, it should be advised by informed policy makers, experts and non-experts with access to proper advice, it should consult with society and listen to the public, there should be a good network to sample opinions, and the decision making process should be open and transparent and demonstrate how all the different interests have been taken into account. One person pointed out that there are several layers of decision making involved and that ultimately farmers should decide, within the parameters set by regulators. Other decision makers mentioned were: the statutory authorities (for decisions about whether a particular product is safe), individual people making individual choices, industry advised by the AEBC, and representatives of citizens approved by society at large and qualified to make 'sensible' decisions. One person specifically mentioned that lawyers and environmental courts were not appropriate for this type of decision. In many respects, the answers reflected aspects of the AEBC's role in advising government, although only two people explicitly referred to the AEBC.

*Q4b) Who is the decision maker?* Many people thought that in this case the 'is' is close to the 'ought' – that government is the decision maker and is making progress towards establishing a more consultative and participatory decision process, for example by setting up the AEBC. More cynical views were that, at least in the past, decisions occurred by default and the government was simply 'rubber stamping' decisions made by others, such as its expert advisers on ACRE. Several groups were mentioned as having undue influence on GM decisions: supermarkets, industry, local protesters and pressure groups such as the Soil Association (which promotes organic agriculture), multinational corporations (in relation to decisions about the development of the technology). As one person pointed out, a distinction needs to be made between official decisions and unofficial decisions that can have a significant impact. At a more overarching level, the CAP was mentioned as a major influence on agriculture's direction because it forces farmers to farm in the most profitable way possible. One person pointed out that at present no-one is free to take decisions – farmers can't choose because there is a moratorium on the commercialisation of GM crops, consumers can't choose because some supermarkets refuse to stock GM products, and the regulatory authorities can't take decisions because the politicians won't let them.

*Q5a) What conditions for successful implementation should be under the decision-maker's control? Q5b) What conditions are under the decision-maker's control? Q6a) What conditions should be outside the decision maker's control? Q6b) What conditions are outside the decision-maker's control?*

Some people had difficulty in understanding the meaning of this group of questions, at least in relation to biotechnology. Others did not always make a clear distinction between the four parts. Part of the problem was that the decision making is still at an early stage and GM crops are not yet being grown commercially. As one person said '*we're not far enough down the line yet to address this question*'. Another commented that at present we have a very restricted view of the relevant knowledge, implying that we can't yet say which aspects the decision-maker should or should not control. In addition, there are several levels at which the question needs to be addressed. At the national level, the prevalent view was that the decision maker should control the aspects relating to health and environmental safety (one person expressed this as 'common environmental/public goods'). Some people also thought the decision maker should have control over ethical components of the decision such as ensuring social benefits, welfare, rights, justice and the acceptability of the processes of production. One person said that all the conditions that society feels strongly about should be under the decision makers' control. The general view was that health and environmental safety *are* at least notionally under the decision makers control, although some people mentioned there are gaps or that the regulatory system is not yet adequately rigorous on the environmental aspects. The question of control of the ethical aspects was seen as more difficult and as one reason why the AEBC was set up.

On the question of what conditions should lie *outside* the decision maker's control, several people thought that (subject to meeting regulatory conditions) researchers and developers should be free to choose what types of research to pursue, and farmers should be free to make day-to-day management decisions. Consumers should be free to choose which products to consume. Government should not control these decisions although it might exert an influence, by setting out its vision, laying down general principles, offering incentives and using its own purchasing power (for example, selecting GM/non-GM products for the health service). Aspects mentioned as currently beyond the decision maker's control (sometimes with the implication of being out of control) were: industry developments, social dynamics, public acceptability and commercial adoption.

One or two people specifically mentioned the international level of control or lack of control. For example, in some cases international control (for example from WTO) may affect national decision makers. Conversely, there is a lack of international control over developments that may adversely affect the economies of developing countries (such as GM substitutes for their crop exports). In relation to the local control measures that would be needed if a decision was taken to go ahead with GM crops, one person mentioned that once the decision maker has put the necessary controls in place, the monitoring to check compliance should be independent.

#### *The expert role (Qs 7-9)*

*Q7a) Who ought to be involved in the research and development of the system?* [For science-related issues, such as GM, this question is ambiguous since it can be understood in a strict physical sense, as R&D of a technology, or in a more general and abstract (systemic) sense as the design of the system.] People addressed this question at different levels. Several people referred to an overarching level to do with the need for a good process to inform the direction of agriculture and provide a framework for biotechnology research. They thought this process should involve finding out society's needs, to target products for which there is a demand, so it should include a broad range of people, a cross-section of the community, as well as drawing on experts such as scientists. There was one view that the scientists involved should include those with an industry background and a contrasting view that they should be independent. Environmental scientists and ecologists were specifically mentioned, as were sociologists/social scientists. One person mentioned the need for new forms of expertise and social intelligence, to help understand such matters as science's limits, tacit social questions, human dynamics and how people reach judgements, and to help overcome mechanistic and complacent thinking. At the level of biotechnology research and development, there were several comments about the need for the public sector to play a bigger role, to address the existing imbalance between private and public sector research. Comments about this public sector role included: that a broad range of publicly funded institutions should be involved not just big industrial companies, that public research funding should be used for the public good, that the government should encourage health and safety research and the training of researchers, that research findings should be freely available and that applied research should not just be left to industry. One person mentioned that industry's expertise and role was in researching profitable products. There was a view that not just the private sector but also the public

sector should consult widely with stakeholders, including NGOs and the public, at an early stage of research and development. Two people referred to the kind of expertise needed at the stage of implementation or technology transfer: one said this should be independent of government once a tough regulatory framework was in place; the other thought there was a need for a cross-cutting body to oversee implementation.

*Q7b) Who is involved in R&D?* As with Q7a, the answers related to several different systems, for example the scientific research system, the policy decision-making system (including the AEBC), and the risk assessment system. In relation to the scientific research system, several people mentioned that it is too dominated by big companies. Even in the public sector, government research council funding is being replaced by industry funding. One person said that it was wrong to separate basic research from applied research, with basic research being done mainly by the public sector and applied research by the private sector. Another said that the private sector should take on more of the burden of basic research. There was a view that the research should be done by independent scientists, rather than funded by groups with particular interests. In relation to the policy decision-making system, several people thought that although efforts were being made to be more inclusive there was still a long way to go. Although people accept that scientific expertise and people with expert knowledge have to be involved at the core of the decisions, the current disciplinary base involved, for example in risk assessment, was seen as still relatively narrow. Decision making was seen as still 'expert-driven', mechanistic and operating in a 'culture of complacency' even though it was acknowledged that some new thinking is going on. One person said the scientists who've been involved with the technology for a long time have become sanguine about it, and have lost the ability to see it as members of the public do 'with fresh eyes'. It was acknowledged that huge efforts have been made over the last two to three years to find ways of involving the 'silent minority', but the efforts have been patchy – local people and farmers need to be involved and ways have to be found to take account of changing views. There is little sign yet of an appreciation of public opinion or of ways to describe it so that it can be taken into account in decisions. In contrast to these mostly critical views, two people thought the system was operating as it should, involving all those who should be involved, at least to some degree.

*Q8a) What sort of expertise should be involved and how?* There was some overlap between the answers to this question (concerning the type of expertise or knowledge involved) and the answers to question 7 (concerning the people involved). Types of expertise mentioned specifically were: scientists (molecular geneticists, physiologists, agronomists), environmentalists, economists, technologists, ethicists, sociologists, the practical expertise of farmers, consumers, NGOs, political expertise, and product and efficiency expertise. Although scientific expertise was seen as central, only one person restricted their answer to scientific expertise, and they mentioned the need to involve the whole range of science and to find out more about the impacts of GM crops, for example on soil and bees. One scientist was wary of involving sociologists. Most people thought a wide range of expertise needed to be involved, with several answers referring to a system with two components or stages, one involving scientific or technical expertise and the other a broader expertise to set the technology in its social context, reflect on society's concerns, subject the science to common-sense questioning, establish the overall strategic direction – much like the AEBC's role in relation to ACRE. One person thought that the social context should be considered before the research (with more attention given to research into urgent issues rather than the 'whims' of scientists), another that the social context (e.g. acceptability and safety) should be considered after efficient products had been developed, and a third saw the need for context setting both before and after product development (before to consider strategic direction and after to consider technology implementation). Two people thought that the term 'expertise' was restrictive and spoke of the need to widen what counts as relevant knowledge. As one said, '*although you have ethical experts, if you have ethical concerns you are not always an ethical expert ... the very fact that they are concerns means they have to be dealt with ...*', that is, people with ethical concerns are not always experts but their concerns should be considered as relevant. How to involve the public and take account of nebulous concerns was seen as problematic. One person referred to the AEBC as providing the opportunity for people 'to let off steam'. Specifically in relation to risk assessment, one person mentioned the need for expertise concerning the cumulative, long-term and indirect effects.

*Q8b) What sort of expertise is involved and how?* As for Q8a, people perceived an overlap between the answers to this question and those to Q7, so in some cases they didn't answer it separately. There was a general view that the expertise involved is narrower than it should be, too much technology-led, and more pure science-based than desirable. Several people commented that this situation is changing and moving in the right direction, for example in the case of risk assessment the expertise involved is



widening, and lay knowledge is being considered although as yet there is no clear framework that allows it to be taken into account. Several people referred to the AEBC's role, for example in discovering the gaps in expertise that need filling. They also referred to the AEBC's struggle to find fair and meaningful ways of involving a wider range of views, particularly among the public. In discussing this struggle, one person mentioned the need to address the tendency for 'fanatics on both sides' to dominate debate and the question of the extent to which environmental groups can be said to represent their members' views.

*Q9a) Who or what should be assumed to be the guarantor or guarantee that the system will work?*

Liability is one of the six topics that the AEBC have chosen to focus on, so most members had already thought about this question. Most people thought that responsibility should lie either with the producers of GM technology or with government or with both. There was a view that those who produce and sell should be responsible for their products and should withdraw them if they are no good, as with any conventional products. While one person said that industry recognised this responsibility, another feared that seed companies would not accept responsibility. Ministers and government were seen as responsible because they make the decisions; they are responsible for providing a safe environment and dealing with any problems. It was recognised that there is no such thing as zero risk, that there is always a level of uncertainty and that it is difficult to foresee the future, so government has to provide a form of insurance and step in if the system breaks down. The need for independent monitoring was mentioned, to provide an early warning system and an opportunity to stop if things go wrong. Two people mentioned the idea of an environmental contingency fund, financed by a levy on beneficiaries (companies, farmers and, to a small extent, consumers) to spread societal risks and compensate for unforeseeable damage. It was a concern that at present there is no room for financial redress – there needs to be clear liability. However, two people noted that recourse to the legal system would not be an appropriate remedy since it would be difficult to assign blame on an individual and take them to court. Another person mentioned that responsibility would depend on what went wrong; for example, it might be the policy framework, or a product, but the negative response of consumers implies that it is the *process* that is wrong. One difficulty in assigning responsibility is the problem of defining what counts as 'harm'. One person suggested a need for an independent regulator (as exists in the UK for example for water supply), who could be called on to arbitrate. One person commented that the UK has to work within a framework [on liability] set by the EU. Specifically in relation to the AEBC, one person said there could be no guarantee the AEBC would work; it was a ground-breaking experiment.

*Q9b) Who is the guarantor or guarantee?* Nearly everyone said that there is no explicit guarantor or guarantee at the moment. There are bits of law that are relevant, for example, the customer has a legal right to compensation if a product doesn't perform as claimed, and a person might claim redress from a company if a product affected their health, but it's not clear who is responsible in the case of environmental harm or long-term consequences. Three people said that one could argue, or people assume, that the guarantor is government and industry. One person suggested that once there is a licensing system, the licence-holder will be the guarantor.

*The 'witness' role (Qs10-12)*

*Q10a) Who should represent 'the affected' (for example, future generations, wildlife?)* Several people thought that everyone should be involved in ensuring 'the affected' are represented. A democratically elected government has a responsibility to steer society in a way that represents everyone, including future generations. Government has to make sure a rigorous regulatory system is in place, with critical evaluation of experts by experts on the long-term issues. One person commented that there should be no need for representation since the interests of the affected should be automatically built into the regulatory system. Several people mentioned a role for groups representing different interests, although one qualified this by adding that those involved should be responsible enlightened groups (such as the Consumers Association and the National Farmers Union). One person mentioned that NGOs should act as a 'backstop', whilst another said that reliance on NGOs to provide this role has to change. Three people mentioned the need for overarching strategic bodies to advise government, to synthesise the views of different groups and the public and represent the affected. Two of these specifically mentioned the AEBC as attempting to fill this role to the best of their ability. However, two people mentioned that ways still have to be found to ensure that existing approaches to harnessing 'unheard voices', 'public sensibilities', and philosophical and ethical questions become a formal part of the decision making process, so that decisions 'go with the grain' of public opinion. Three people mentioned the problem of ephemeral companies and government ministers in relation to taking account of the long-term view. One person commented that government's role in representing 'the affected' is

diluted by the effects of globalisation. One person challenged the assumption implicit in the question, that there will be negative effects, saying that companies are conscientious about not causing harm.

*Q10b) Who does represent 'the affected'?* About eight people said that in practice NGOs had taken on this role, but the attempts by NGOs to get other voices heard and act as 'guardians of the social context' was not necessarily viewed as satisfactory. One favourable comment was that NGOs' arguments help to draw out people's views and that NGOs have longer memories than companies and civil servants. A more critical comment was that some NGOs are more concerned about increasing their membership than about representing their members' views. Some people thought that the 'is' is close to the 'ought', in that government and strategic bodies do try to think of the environment and other generations, and that the range of bodies involved ensures a range of perspectives are considered. Other, more critical, comments were that no-one in particular is assigned an advocacy role and it is unclear who should speak for 'the affected', only a proportion of stakeholders have a say, interest groups are involved in an ad-hoc way, the representatives are self-appointed, and that evaluation of GM crops does not look far enough into the future. One person who commented that independent organisations should represent 'the affected', thought that the National Consumer Council and the Food Standards Agency provided good examples but was less sure about English Nature and the Environment Agency.

*Q11a) To what extent should 'the affected' be given the chance to escape or challenge the promises and premises of 'the involved'?* Several people found this question odd or asked for it to be repeated. Most expressed in quite strong terms the view that everyone should have the right to challenge (one person added, provided they kept within the law and were well-informed) and freedom of choice (for example, by the labelling of GM products). There were several remarks about how these rights could be handled effectively and responsibly. For example, there are practical difficulties involved in labelling, and in ensuring that challenges come from responsible and representative groups. There were two related comments about the need for government to make rigorous attempts to gather views and the need for people to feel that decision makers understand and consider their concerns, but also comments that the government can't ask every individual, that it has limited capacity to respond to consultations, and that many views are not expressed. One person commented that people rarely have access to the resources and expertise they need in order to challenge decisions – a way needs to be found of balancing the power of the 'affected' with that of the 'involved'. Three people commented that opting out ('the chance to escape') will not be an option, or will be extremely difficult since, they argued, GM contamination affects people's ability to choose to buy, eat or live near non-GM products or crops. One added that this lack of choice makes it all the more important that everyone has the opportunity to be involved in GM decisions and that future generations are considered, since the implications affect everyone. The need to resolve the tension between organic farmers and farmers who grow or would like to grow GM crops was mentioned, as was the need to do further work on separation distances required to allow co-existence of GM and non-GM crops and the need to compensate farmers whose produce is affected by GM contamination.

*Q11b) To what extent are 'the affected' given the chance to escape or challenge?* People tended to make a clear distinction between 'escape' and 'challenge' and answer in relation either to one or to the other; only two people responded to both. On the question of 'escape', three people pointed out that since there is little commercialisation yet, the question is not yet relevant. Two of those observed that the lack of commercialisation meant that farmers and consumers were not free to choose to buy GM. Two people mentioned that labelling will allow people to choose to avoid GM in future. Two people said that escape is difficult or impossible – the consequences affect everyone. Three people talked of escape in terms of what might happen if adverse impacts occurred: one mentioned that legally if there was evidence of harm then commercialisation could be stopped, one mentioned that environmental groups are arguing for compensation, and one mentioned that there are real concerns about the question of liability in the case of environmental harm. On the question of 'challenge', three people thought that there are now opportunities at public meetings and that government is becoming more aware of people power. However, several others expressed reservations about these opportunities or pointed out the difficulties. For example, one said it is easy to say there must be public consultation, implying that in practice it's difficult, a view reinforced by another person who commented that sampling public opinion is difficult and that people's views can depend on their experience that day. One mentioned that people's concerns are not understood within the current decision-making process and are dismissed because they don't fit into the scientific discourse. Another, referring to their previous comment about

the need for more balanced access to expertise and resources, said that the imbalance at present is enormous, so that a challenge is only possible if a very well-resourced NGO is involved.

*Q12a) What worldview should underlie the design of the system?* This is a big and open-ended question. One person commented 'Is there a given set from which to choose?' Nevertheless, most people (including this person) had little difficulty answering the question. Many expressed fundamental ethical beliefs. For example, the worldview should be inclusive, tolerant, egalitarian and equitable – a just society for humans and non-humans; it should consider the long-term, our dependence on resources, it should be global, flexible and inclusive; it should be based on equity, fairness and justice, with long-term planning; it should accept responsibility for future generations and other inhabitants of the planet, it should respect the integrity of species, it should value equal opportunities, it should not exacerbate the divide between rich and poor, it should be humble about our ability to see the whole picture; it should be a balanced worldview, about providing opportunities for society – health, welfare and quality of life – but also about valuing economic strength; it should encourage progress but with huge caution. Some answers were less fundamental, in that they referred more specifically to the UK context, or to agriculture, food and gm. For example, the worldview should be realistic about the social context, about what we do and don't know, and about what can and can't be achieved in the context of British society; it should be one that accommodates a diverse agriculture and provides a genuine choice for society within the practicalities of agriculture; it should be about feeding the world and doing it sustainably; it should be one that ensures biotechnology is implemented in such a way as to benefit the environment and health worldwide; it should be one that allows each country to have the right to self-determination and not be forced to accept a technology; it should be a worldview that allows people to feel that all the research that could be done has been done before gm is introduced. Three people referred to the importance of considering everyone's worldview rather than allowing a particular worldview to dominate, and mentioned how difficult this was to achieve in practice – for example how much weight to give to different viewpoints, what can be done about views that aren't expressed. One of these mentioned the tough process of trying to reach some form of accommodation in the AEBC among members with diverse worldviews, describing it as 'sanding down': *'I think all of us, particularly the scientists, have changed our worldview over the last six months of some very emotional times together, and a lot of shouting. So I think you have to somehow build into the design of the system a worldview that's been contributed to by, and almost sanded down by, people with different worldviews because I think we're getting there almost. I'd say we've got a more common worldview now than ever we thought we would.'* One person took the term 'worldview' to mean a single world view, answering that there's no such thing, but adding that there's a danger of the western view being seen as the world view, for example the western NGOs who presume to speak on behalf of Indian farmers.

*Q12b) What worldview does underlie the design of the system?* The contrast between the idealistic answers to the 'ought' part of the question and the answers to the 'is' part was quite stark. The most strongly worded answer was that the worldview is one of 'rampant unfettered capitalism'. Other people made related points, though less forcefully, for example: economic imperatives hold sway; market forces; short-term competitiveness based on rapid financial returns; the profit motive. Several made the point that the dominance of the economic motive distorts a more balanced view that takes into account other values such as health, welfare and quality of life, or at least only pays lip service to it. One person mentioned that it is a worldview that is technology driven, rather than benefits driven, and another said that scientific claims are dominant. One said the worldview is one that holds that the biological world is at our service, to be manipulated for our benefit. Two people said that the worldview is that gm technology is a good thing and should go ahead unless there is evidence of harm. Several answers referred to the people or groups who hold the dominant worldview. For example, one said that since America is the home of gm and the biggest nation in the world, their worldview predominates, which plays into the hands of gm opponents because people don't like being pushed around. A related comment was that the worldview is that of the big players, although the opposition has halted the big players at present. One person distanced themselves from their answer by referring to it as a public perception - the worldview is that of the developers of the products pursuing their own ends, which are not in the interests of the consumer. Two people referred to the danger of the western view being assumed to hold everywhere, for example, NGOs are arrogant in assuming they speak for others.

## 5 Discussion

The CSH questions prompted people to reflect deeply on their own beliefs and values, in some cases on aspects of the gm debate they had not previously considered. People described the questions as 'searching' and 'thought-provoking', raising relevant issues. Some people mentioned that they would have liked more time to take in the questions or to think them through more carefully, or would have liked a 'crib-sheet' to remind them of the questions when their chain of thought led them away from the main focus. Overall, we conclude that critical systems heuristics is an approach that merits further investigation as a practical tool to incorporate ethics and values into complex policy decisions such as those surrounding biotechnology. In this section we first make a few general observations about the results, then discuss some of the aspects of the approach that need further thought and development.

### *General observations*

Summarising such detailed answers proved difficult. Summarising the analysis under question headings provides some comparison of the diverse viewpoints but loses the links that an individual makes between different questions and that provide an indication of their overall values and concerns.

Some of the questions had been considered previously by this group of people, so were answered fairly easily, for example the question of the guarantee or guarantor had been discussed by the AEBC in terms of liability. Many of the other questions had not been considered previously by most people; they often spent some time working their way to an answer in these cases, for example on the purpose of the system.

Occasionally the answers to the 'ought' and 'is' parts of the question were similar, for example for Q4 on the decision maker. Proponents of biotechnology were more likely to perceive a near correspondence between 'ought' and 'is'. Much more often people acknowledged that there was a wide discrepancy between the way they thought things ought to be and the way they perceived them to be at present, for example for Q1 on the intended client or beneficiary, although they sometimes commented that the situation was changing.

For some questions there was a considerable measure of agreement, for example on Q1a and Q4.

Recurring topics, raised in relation to several questions, included the difficult question of how to involve the public in a meaningful way and how to make sure that the views heard are representative rather than limited to a vociferous but unrepresentative minority.

### *Defining 'the system'*

Other than saying that the questions referred to biotechnology, we deliberately left the definition of 'the system' vague, so as to allow people to define their own relevant system and its boundaries. Most people felt uncomfortable with this initially, and checked at least once, especially during the first two questions, what was meant by 'the system'. With hindsight, we perhaps should have spent more time explaining the basis of the approach – that it views the system as being constructed by an individual's perceptions rather than as an objective entity. One way to do this might be to work out a systems map (or maps) with the person being interviewed before starting the questions, basing the map on the aspects of biotechnology they consider to be the most relevant and amending, or adding to, the map as the questions are answered. A compromise between leaving the definition of the system up to the individual, or providing them with a precise definition, would be to focus on a particular system such as the regulatory system while still leaving open the question of that system's components and boundary. This might be the appropriate approach if the CSH set of questions were to be used routinely to check values regarding a specific decision at a specific time.

For this test of CSH, we deliberately chose a highly articulate group of people with diverse expertise. One way of extending the approach to broader, less knowledgeable and less articulate groups might be to use the answers from the articulate group to define diverse relevant systems, then use those as the basis for a more focused set of questions, and a selection of answers, with the wider groups.

### *Language and accessibility*

The wording of some of the questions is awkward and unfamiliar, making their meaning difficult to understand. For example, people found the wording of Q11 in particular 'tortured' and 'odd' (To what

extent should the 'affected' be given a chance to escape or challenge the promises and premises of the 'involved'?). One scientist referred to the wording of the questions as 'sociology speak': '*They're not accessible to someone who doesn't use that kind of, I'm not sure, I guess it's sort of sociology speak as opposed to science speak*'. For use with a wider audience it will be particularly important to reword the questions so that they are easy to understand.

#### *Different 'hats'*

People sometimes answered questions by referring to other people's views rather than to their own, for example, in answer to Q1b (Who is the beneficiary?): '*The public perception is that the benefits go largely to the developers and companies*'. In some cases this seemed to be a way of distancing the person from a critical view; in other cases it was used to express a widely held view that was contrary to the person's own view.

A somewhat different but related point is that people sometimes wondered which 'hat' to wear in answering the questions. The type of people who are appointed to committees such as the AEBC tend to have more than one occupation or role, for example they may be a farmer, a member of an industry body and a local council member. One person commented that he had eight different 'hats' and could potentially answer the question in a different way for each of them. Sometimes it was clear from the answer that a person was speaking with a specific hat on, for example as a lawyer by commenting on the legal aspects.

While the issue of 'hats' might be important if CSH were being used to map out a particular person's beliefs and values, in general it should not be a problem, since part of the purpose of CSH is to explore differences in boundary judgements and each 'hat' makes a valid contribution to this purpose.

#### *Overlapping questions or answers*

People occasionally commented on an overlap between questions, or in their answers to two related questions. For example, one or two people felt that in answering Q1 on the client or beneficiary they had also answered Q2 on the purpose – if the client of gm risk assessment is the general public, then the purpose is to serve the general public. Other people commented on an overlap in their answers to Q7 on the expert (Who ought to be/is involved in research and development?) and Q8 on expertise (What sort of expertise should be/is involved?). Quite often the answers to the 'ought' and 'is' questions were mixed together. In part, this is because in working out their answers, people did not compartmentalise their thoughts under the separate headings or in the linear sequence of the questions. Sometimes their answer to one question prompted further reflections on an earlier question. Overlapping answers can make analysis difficult and may be a problem if the purpose of the questions is a rigorous comparison of views. However, if the purpose is to encourage critical self-reflection and an exploration of values or boundary judgements, then a somewhat flexible approach to the interview questions avoids checking the interviewee's flow of thought.

In the case of Q5 (What conditions for successful implementation should be/are under the decision-maker's control?) and Q6 (What conditions should be/are outside the decision-maker's control?), after the first few interviews we always asked these questions together. This was because people had difficulty deciding on the scope of Q5, so that asking Q6 at the same time helped to explain this. Even so, people did not find this set of questions easy to answer, as already mentioned, partly because implementation (in the case of the commercial growing of gm crops) has not yet occurred in the UK.

#### *Two questions in one*

Three questions have two parts to them. Q7 asks about research *and* development; one person commented that research tends to be about fundamental science whereas development is about the application of science, so the answer for each might be different. (There was a further slight difficulty with Q7, in that research and development (R&D) has a precise meaning in the context of science and technology, whereas it might have a more general meaning in the context of planning. People sometimes answered it in the specific sense and sometimes more generally.) Q8 asks what sort of expertise should be involved *and* how; nearly everyone overlooked the second part of this question. Q11 asks about escape *or* challenge, and promises *and* premises; some people did try to answer each

part of this question separately, though most answered only one part. Restricting each question to one part would make the meaning clearer.

None of these criticisms alters our initial view that critical systems heuristics is a potentially useful tool for including ethics and values in complex policy decisions such as those associated with biotechnology, and that it might help to address some of the current criticisms of the gm decision-making process. Ulrich suggested that critical systems heuristics can be used in three modes. It can be used self-reflectively, encouraging individuals to ask themselves 'What are my boundary judgements?'. It can be used consensually, allowing groups to ask 'Can we agree on our boundary judgements?'. And it can be used conflictually, allowing critics to ask 'How can we challenge your boundary judgements?'. In this test we have used it in the self-reflective mode. From the rich and thoughtful answers given to the questions, and the comments made about the searching nature of the questions, it is evident that the people interviewed did find that it encouraged self-reflection. It would be useful to test it consensually with the same group of people, not necessarily to try and achieve consensus but to establish where agreement can and cannot be reached. Comparison of boundary judgements within a group setting might encourage further critical self-reflection.

It seems likely that further development will be needed before the use of this tool can be extended to a wider, less knowledgeable and less articulate audience. Nevertheless, it seems well worth making the effort if the result is a more inclusive process that allows and encourages people to question the values that inform the decisions taken on their behalf.

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**Table 1 Critical Systems Heuristics checklist of roles and questions**

<b>The client/beneficiary's role</b>	
<b>Q1</b>	Who ought to be/is the <b>client</b> or <b>beneficiary</b> of the system?
<b>Q2</b>	What ought to be/is the <b>purpose</b> ?
<b>Q3</b>	What ought to be/is the <b>measure of performance</b> ?
<b>The decision maker's role</b>	
<b>Q4</b>	Who ought to be/is the <b>decision maker</b> ?
<b>Q5</b>	What conditions for successful implementation should be/are <b>under</b> the decision maker's <b>control</b> ?
<b>Q6</b>	What conditions should be/are <b>outside</b> the decision maker's <b>control</b> ?
<b>The expert's role</b>	
<b>Q7</b>	Who ought to be/is involved in the <b>research and development</b> of the system?
<b>Q8</b>	What sort of <b>expertise</b> ought to be/is involved and how?
<b>Q9</b>	Who or what should be/is assumed to be the <b>guarantor/guarantee</b> the system will work?
<b>The 'witness' role</b>	
<b>Q10</b>	Who should/does represent ' <b>the affected</b> '?
<b>Q11</b>	To what extent should/are the 'the affected' be given the chance to <b>escape or challenge</b> the promises and premises of 'the involved'?
<b>Q12</b>	What <b>worldview</b> should/does underlie the design of the system?

**Table 2 Membership of the UK's Agriculture and Environment Commission**

Scientists	GM crops and biosafety Molecular biology, medical Ecologist Nature conservation/biodiversity Land use
Farmers	Organic meats, tenant farmer Arable see production Arable (non-food crops)
Public interest groups/bodies	Green Alliance GeneWatch UK National Consumer Council
Lawyers	Land economist/lawyer Barrister (environmental law)
Philosophers	Theologist Applied bioethicist/food ethics council
Other	British Society of Plant Breeders Sociologist (environment and society) Broadcaster and writer (science) Industry consultant Health service layperson