ESRC
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Programme

The politics of GM food

Risk, science & public trust

A research-based analysis that reveals why controversies such as BSE and genetically modified food seem to throw British Governments and business off balance how to get out of the GM impasse and how to avoid these problems in future.

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Hot story, slow burn

In 1995,ESRC-funded researchers from the Centre for the Study of Environmental Change (CSEC) at Lancaster University predicted that,sooner or later, major problems with public acceptance of GM food would surface. To investigate the issues around the regulation of GM food,CSEC and the consensus-building group The Green Alliance organised a series of three meetings with regulators,industry and environmental groups.These meetings identified serious problems with the regulatory arrangements.None of the three main groups involved were confident in the regulation of GMOs and major gaps in responsibility were identified (Mayer et al.1996).

Following these meetings,CSEC undertook a major study of public attitudes to GM food. The subsequent report has steadily made a significant impact on UK policy on GMOs. Entitled Uncertain World:Genetically Modified Organisms, Food and Public Attitudes in Britain (1997), it has been cited by the specialist journal ENDS as 'The study which has provided the deepest insights into public attitudes towards GM foods' (ENDS Report 283, August 1998).More recently, Sir Robert May, the Government's Chief Scientist said 'I now have had a chance to read 'Uncertain World', which I wish I had indeed read earlier. It is in many ways a remarkably prescient document' (March 1999).

The report's findings have had a significant impact on policy debates,in particular the Royal Commission on Environmental Pollution's now highly regarded report on Setting Environmental Standards.This in turn has enlightened several inquiries in both the House of Commons and House of Lords which have put Ministers under pressure to explain the adequacy of the existing regulatory arrangements for GMOs.

The researchers have been involved in a wide array of policy consultations at high level in Government - but note the absence of any serious context where discussions of an appropriate kind between researchers and officials can take place.

Setting the scene

By focusing on the detailed scientific and technical issues, much of the debate over GM food is missing the real point. The deep-seated causes of this and previous controversies are the political and ethical difficulties of handling the uncertain effects of new technologies. Over many years, governments have mishandled such issues because they and their advisors have misunderstood or denied the character of the problems.

In 1995, ESRC researchers taking part in the Global Environmental Change Programme warned that the Government would, sooner rather than later, run into serious public difficulties in its handling of genetically modified food (see Hot story, slow burn). It took nearly four years for the prediction to come true, but when it did, the controversy rapidly became one of the Government's biggest headaches. Ironically, this is a Government that prides itself in its ability to stay in touch with public opinion. So what went wrong? Why have successive Governments seemed almost wilfully to ignore the insights of research on these issues? Are there lessons to be learned from nuclear power, BSE and Brent Spar for the management of GM foods?

Much of the debate has been polarised between pro- and anti-GM voices, each side labelling the other as irresponsible in various ways. What has largely been lacking is a careful analysis of the way such issues can be handled better by government and firms; that is what this document sets out to do. It brings together the findings of research funded by the Economic and Social Research Council as part of its Global Environmental Change Programme (see box 1). Further more detailed publications by way of supporting evidence are available on the web site www.gecko.ac.uk.

In this document, our aim is to suggest more effective ways of handling political decisions in the face of uncertainty. We emphasize the central need for public involvement in issues that are inherently ethical in nature rather than purely scientific.

In the next section, some of the main political and scientific problems involved in regulating the use of GM foods are analysed. We finish by identifying political solutions to the specific GM problem and future similar 'risk' issues.

Box 1

The Global Environmental Change Programme is in its final year. Supported by the Economic and Social Research Council, the Programme has run since 1991 and will end in June 2000. It has supported 150 empirical research projects, Fellowships and PhD studentships across the UK including all the contributors to this briefing.

In the final year, the main priority is to ensure that the greatest possible benefit is derived from this research investment. We will be engaging decision-makers from a range of organisations in discussions based around the findings from the Programme's research, as well as disseminating the findings more widely. These discussions will be based around three topics:

- decision-making under environmental uncertainty
- governance of the global environment
- sustainable production and consumption

The problems now

In an increasingly technological society, the ability to manage the introduction of new technologies and practices is an essential skill for governments and firms.In our 'risk society', a range of potential risks and uncertainties are associated with new technologies that bring with them worries about human health,industrial competitiveness, ecological disruption, and the potential for trade disputes.

Senior politicians frequently stress the need for decisions on GM food to be made in the light of 'sound science'.Their approach to public unease about the technology has often been to characterise the public as ignorant, irrational or even hysterical.

If anything, the public are ahead of many scientists and policy advisors in their instinctive feeling for a need to act in a precautionary way

Yet the evidence from research is that many of the public, far from requiring a better understanding of science, are well informed about scientific advance and new technologies and highly sophisticated in their thinking on the issues.Many 'ordinary' people demonstrate a thorough grasp of issues such as uncertainty:if anything, the public are ahead of many scientists and policy advisors in their instinctive feeling for a need to act in a precautionary way. What is more, our research calls into question the validity of the notion of 'sound science', on which politicians are inclined to rely.This is at a time when the implementation of the precautionary principle is a highly charged political, legal and scientific issue, not least with respect to trade issues.

This is the larger political context within which GM developments are situated:how to make decisions in the face of uncertainties while at the same time implementing precautionary approaches under fierce commercial and trade pressures. We will suggest that science cannot provide definitive answers in these cases,so the policy of relying on claims of 'sound science' may, ironically, itself be unsound.Ethical issues are central.

Building the legitimacy and accountability of political decisions on GM food requires a much more participatory style of decision-making,in which a far wider range of options are considered.The outcomes of this process cannot necessarily be foreseen.This would require politicians and scientific advisors to make significant changes to their ways of making decisions. Not least it would require a sharing of power over the process and possible outcomes, although this short term sharing of power should ultimately result in enhanced powers to act.The consequences of this logic have not been fully accepted in political and scientific advisory circles,with the result that entrenched but manifestly unsuccessful approaches prevail.

The policy of relying on claims of 'sound science' may, ironically, itself be unsound

Governments need to reconcile a number of objectives in managing GM technology. We know that the Prime Minister is committed to a vision of the UK becoming a 'knowledge economy', and sees biotechnology as an important part of this. So powerful parts of the Government consider that their first objective is to support a modern, knowledge-intensive industry that has the potential to generate high-skill jobs, economic growth and a higher quality of life.

Government also has the job of ensuring safety for consumers and the general public, and protection of the environment.This involves making informed decisions about potential effects on human health, ecology and the countryside more generally.The central question is how these decisions can be made when the technology, and therefore the information on which decisions must be based,are subject to such profound and open-ended uncertainties.

This is the first of a range of problems with the way in which Government is grappling with the GM issue and beyond.These problems are explored next, and include:

- the role of science
- official characterisations of public perceptions, and
- defining the task for regulators.

Science cannot answer all the questions

Science seeks to provide explanations for natural processes based on theory and evidence. But the way that scientific advice is used is heavily influenced by the way the official advisory system is put together. Until recently, this has been determined by a precise yet narrow interpretation of the sorts of knowledge required to form judgements about GM technology. For example, no ecologists have been included in the various advisory committees.

Research also questions the widespread assumption that the safety and acceptability of commercial GM agriculture can be settled by science alone (Wynne 1999). Summarising recent research, Brian Wynne challenges this assumption on various grounds, including:

- genetic specimens used in tests may not be replicable when produced industrially, since existing production is more hit-and-miss than admitted;
- crucial factors are excluded from the tests, such as the influence of birds, due to the fact that they circulate wider than the single-farm 'laboratory', and;
- while demanding rules are imposed on crop management for tests, no systematic assessment is made of the extent and consequences of variation from these artificial conditions in real world uses of the technology.

What is more, in assessing the benefits and costs of new technologies,science faces a fundamental difficulty: not much is yet known, and there may be scientific disputes about what is. Beyond this, there are all sorts of things we don't know that we don't know: remember CFCs and their unexpected damage to the ozone layer. In the face of uncertainty, there are two options: to conduct experiments to generate new information, or to make informed guesses about the potential effects of the technology. Either way, scientists are often under real pressures to reach conclusions that can inform commercial and political decisions (see box 2).

Research questions the widespread assumption that the safety and acceptability of GM agriculture can be settled by science alone

Chasing the will'o'the wisp?

Box 2

Science does not only have problems producing conclusive evidence about the impacts of new technologies. It is also ill-equipped to tackle the diffuse effects of existing technologies. In a global review of the evidence, Dr Chris Williams attempted to build a comprehensive picture of the evidence concerning the health effects of industrial hazards, and in particular how these are damaging people's brains (Williams 1997). He found that science has great difficulty in rising to the challenge, for several reasons:

- Science generally analyses the effects of single substances,while many of the most serious problems involve interactions between different industrial hazards, such as lead and fluoride (when added to water, fluoride increases the absorption of lead from pipes). Few comprehensive studies of multi-substance hazards have been undertaken due to lack of funding.
- The complexity of the issues means that scientists who undertake such studies risk arriving at inconclusive results.
- Clear results in a more narrow field of study bring more recognition.
- There are often long time lags and large distances between cause and effect.
- Scientific evidence of hazard or harm is frequently ignored, suppressed or attacked.
- Scientists themselves are unwilling to undertake such studies due to the above factors and the effect that these might have on their careers.

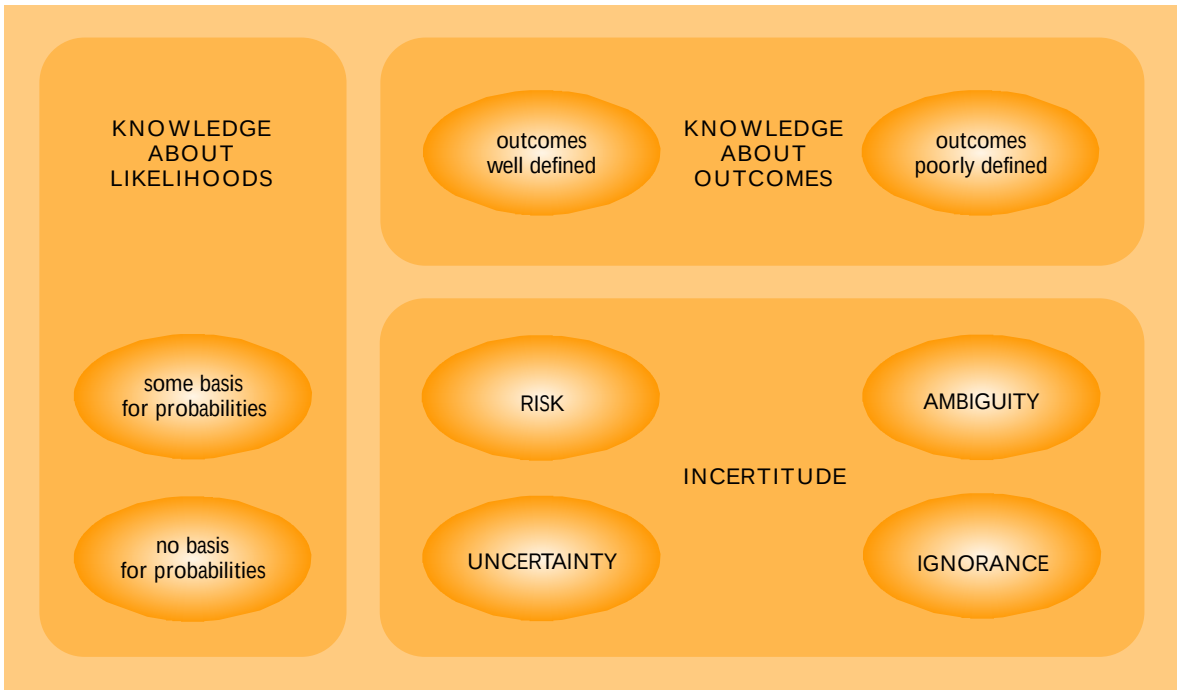
These problems also affect the risks associated with GM foods.The lack of research about diffuse effects makes our prevailing 'single-substance science'appear an inadequate survival skill. Given the central role of science in creating, regulating,tracking and controlling technologies, science itself needs to look to its own practices and commitments if it is to play a full and socially responsible role (Williams 1997 and 1998).

This is the issue at the heart of the role of science in policy-making on new developments such as GM technology. As argued for many years by Brian Wynne and pointed out by Andrew Stirling in recent work for the European Commission,standard risk assessments are unable fully to characterise the fundamental risks and uncertainties associated with the potential impacts of a new technology.

'There is a great deal of uncertainty about what the truth and the facts really are'
Michael Meacher, Environment Minister, 29th April 1999
(Environmental Audit Committee inquiry on GMOs and the Environment para 277)

In this context 'risk', in the technical use of the word, applies only when both probabilities and outcomes can be well defined. Since, by definition, we typically have little knowledge about the impact of new technologies, it is impossible fully to quantify any associated risks: we are dealing with uncertainty. Moreover, where we do not even know the range and character of potential impacts and the different combinations in which these might occur, we are dealing with both uncertainty and ignorance (see figure 1).

Fig 1 Risk, ambiguity, uncertainty and ignorance



The sources of some of this uncertainty are inherently social and economic in character, and may never be resolved by conducting more scientific research.These issues of uncertainty and ignorance are now the subject of a well-developed academic field of study and comment by social scientists, much of it in the UK.Yet there appears to be little familiarity with, or at least acceptance of, this knowledge in policy circles.

Scientific judgements on risks and uncertainties are underpinned and framed by unavoidably subjective assumptions about the nature, magnitude and relative importance of these uncertainties. These 'framing assumptions' can have an overwhelming effect on the results obtained in risk assessments. This partly explains why different risk assessments on the same issue can obtain widely varying results, even though each has apparently been conducted in accordance with the tenets of 'sound science'.

What assumptions frame scientific assessments of risk?

The UK system of scientific advisory committees has yet to address the implications of the intrinsic subjectivity of framing assumptions in risk assessment. But the significance of this matter is at least now coming to be recognised by bodies such as the Royal Society, the DETR and the Royal Commission on Environmental Pollution, particularly in the latter's 21st Report on Setting Environmental Standards (RCEP 1998).

The point to emerge from research is not that any set of framing assumptions is as good as any other but that, in any given context, more than one set of assumptions may be equally reasonable in appraisal (Stirling and Grove-White 1999). The adoption of any particular set of framing assumptions in risk assessment must therefore be justified. Such justification cannot be undertaken in terms of 'science' but must rather be assessed in terms of factors such as:

- the legitimacy of the institution making the justification
- the degree of democratic accountability to which the institution is subjected, and
- the ethical acceptability of the assumptions adopted.

Yet the assumptions embedded in risk assessments on such issues are rarely examined, despite the existence of straightforward techniques for doing so. This is clearly an area in which great improvements can be made, and will be addressed in the final section.

'Absence of evidence' of risks is not the same thing as 'evidence of absence'

When they look back at previous controversies such as BSE and Brent Spar, senior civil servants and scientists are often candid about the inherently provisional character of most scientific understanding of environmental problems, and that these understandings can be radically revised in the light of new evidence. However, faced with political crises surrounding new issues such as GMOs, there appears less enthusiasm for admitting the limits to the relevant scientific knowledge. Scientific advisors therefore need to be more explicit about these limits in their dealings with issues such as GM, and politicians must take care not to portray an 'absence of evidence' of risks as 'evidence of absence'.

In the light of previous reassurances about safety on issues such as beef/BSE and nuclear power, the public now has a well measured mistrust of such statements. In focus groups conducted by the Centre for the Study of Environmental Change (CSEC, University of Lancaster) 'Claims of safety and 'no scientific evidence of harm' were treated with scepticism, and even derision' (Grove-White et al. 1997). This issue goes to the heart of the way in which public reactions to GM foods have been perceived and treated in Government, as discussed next.

Inaccurate characterisation of public perceptions

To assume that the public is ignorant is not only patronising, but inaccurate and damaging

Government officials and politicians often express frustration at the 'inaccurate and emotional'reactions of the public in the GM debate. Often campaign groups and the media are singled out as the villains of the piece, guilty of spreading hysteria through stories that are based on half-truths or unproven speculation.

But to assume that the public is ignorant and gullible is not only patronising, but inaccurate and therefore damaging to the debate. Global Environmental Change Programme research reveals that people's understandings of the issues are very much better developed than these characterisations imply. Their reactions are informed especially by the dramatic, costly and confusing case of BSE (see box 3).

People may not know the scientific and technical detail, but they have developed a sharp awareness of the broad issues involved and ways of forming judgements of their own (see box 4). In particular, the public mistrusts the scientific approach to ignorance - unknown factors that may lead to 'surprises' in the future.

Tim O'Riordan has found that some senior scientists have recognised that there is nothing irrational about perceptions of risk shrouded in judgements about fairness and justice. A report for the Royal Society, jointly authored by the Chief Executive of the Natural Environment Research Council Sir John Krebs, states that:

'Disagreeing with a scientific estimate of risk is not necessarily irrational: the evidence on the analysis may be incomplete, the scientist may have a vested interest in selecting particular bits of evidence, or there may be more than one particular interpretation of the facts. Interestingly, surveys show that within the European Union,people in those countries with the best understanding of how science works, also tend to be the most sceptical about the ability of science to resolve everyday problems' (Krebs and Kacelnik 1997 cited in O'Riordan 1999).

Even now, as pointed out by Tim O'Riordan, few politicians, nor most in corporate head offices yet realise this (O'Riordan 1999).Given past experiences with BSE and other controversies, it seems both reasonable and rational to many people to harbour doubts about the reliability of regulatory science: once bitten,twice shy.

When most of us do not feel able to assess the risks ourselves, we tend instead to judge those that create the risks or regulate them.The UK Government has so far appeared to adopt a strongly pro-GM position. Many people feel that since the Government is positive towards the technology and the underlying science, this means that it has also sided with the industry. For many, this undermines the Government's independence.

Box 3

Memories can't wait: the echoes from BSE

'Repeatedly, the BSE crisis was mentioned in support of people's expressions of unease at possible dimensions of biotechnology. Not only was the recent history of official handling of that crisis used to illustrate a perceived tendency towards mendacity and 'cover-up' where powerful industrial interests were at stake, but it was also held to show the unreliability of 'scientific'reassurance in such fields'.

'Thus the risks of GMO foods tended to be influenced by experiences with BSE, and were seen as of the same class of risk - in terms of

- unnaturalness
- the failure of institutions to prevent them
- the long-term character of associated risks
- and our inability to avoid them' (Grove-White et al.1997).

As Monsanto found in its own research leaked in November 1998, when people were told that GM crops are regulated by Government, people's levels of mistrust increased (Financial Times 18th November). What is more, CSEC's research found that from the perspective of the outsider, Government and the regulators are often thought to be the same thing. Since the Government appears to be in favour of GM technology, many people assume that the regulatory advisors are similarly in favour. Independence and trust become key issues in determining people's attitudes to the technology.

Independence and trust are key issues in determining people's attitudes to the technology

At the same time, many members of the public are open-minded in discussing the potential benefits attached to genetic engineering. The CSEC research showed that while generally wary of GM technology as 'meddling with nature' people will, given the chance, reach very different conclusions about the relative merits of using genetic engineering to produce tomato paste or to transfer human genes to promote growth in pigs. Most seem much more willing to accept medical uses for GM technology.

So there is much evidence to suggest that the assumption of public ignorance is wrong on a number of fronts:

- Individuals do not have one opinion about biotechnology - many harbour conflicting and variable opinions about different uses for GM technology.
- Different people display a variety of divergent values and perspectives on the technology.
- Public opinion is tainted by recent experiences with scientifically-mediated crises.
- Focus on the public's ignorance over-emphasises the importance of knowledge about the technologies while ignoring the central role of trust in deciding how people judge them.

Many members of the public are open-minded in discussing the potential benefits, as well as the risks, attached to genetic engineering

But people also want to know how their broad concerns are being dealt with as the Government handles genetic engineering. Is the technology needed? Who stands to gain and lose from it? How are ethical issues considered? Unfortunately, the current regulatory system does not have answers to these questions. This leads us to the next problem - the narrow remit of those charged with regulating the use of GM crops.

Selling Trust? GM foods and the public cheater-detector

Box 4

The British public did not need to know about genetics to judge Monsanto when it forced the mixing of GM and non-GM crops in the food chain, making it virtually impossible to buy guaranteed GM-free supplies of soya. To many people, this appeared to be a deliberate strategy aimed at ensuring widespread use and therefore enforced acceptance of a GM product. Monsanto is perceived to be in the wrong because 'good guys don't cheat' - they don't need to. This has been compounded by the Advertising Standards Agency's recent judgement that Monsanto's advertisements have been misleading.

Similarly, claims by supermarkets that GM foods are safe have proved inconsistent. In 1996, Tesco produced a customer leaflet, Genetically Modified Soya - THE FACTS. This claimed that, 'Processed soya beans grown on genetically modified plants ... are indistinguishable in composition ...from those made using conventional soya beans'. Yet tests developed for MAFF can detect a distinction if only one percent of beans is GM.

Tesco then claimed it was 'unable to label those products that contain GMOs': 'We do not believe that it is helpful to customers to use statements such as, 'may contain GMO' as this reduces customer choice'. But soon the food industry announced that products that may contain GMOs would be labelled - to assist customer choice. These inconsistencies in approach serve to further undermine public confidence in the honesty of the information being provided.

Crisis management consultants were soon brought in. They advised companies like Tesco and Monsanto to avoid public discussion, and Tesco refused to answer further research questions. One important lesson of this example is that, as with Brent Spar, almost irrespective of the science or the law, it is the dynamics of public opinion around the world that have dictated the behaviour of otherwise powerful companies (Williams 1998).

Narrow remit of regulators

A range of Committees advise the UK Government on GM food. Until recently, these committees have each had relatively narrow remits and many of the issues of public concern over GM food have not been addressed by any of the Committees.

Research has found that particular difficulties have been posed by the one-at-a-time, product-by-product character of the assessments used by the key Committees. The limited basis for existing scientific advice and the way it is framed have left such committees under-equipped to provide the desired comprehensive, scientifically robust underpinning for regulatory decision making in this area (Stirling and Grove-White 1999).

Many issues of public concern have not been addressed by any part of the regulatory system

Some of the issues left unaddressed include:

- the need for GM foods and the social benefits envisaged from GM strategies
- the potential for indirect, cumulative and synergistic ecological and/or health effects arising from GM crops and foods
- the wider effects on the agricultural industry and on the countryside (see box 5)
- how to compare the significance of the risks and uncertainties - such as for human health, biodiversity, pesticide use - that are attached to different agricultural strategies
- the degree of public control and international pluralism that might be desirable and possible in a global food system dominated by a small number of large companies
- the contribution to global food production and the elimination of hunger (see box 6)
- systematic and transparent ways for regulatory appraisal to take account of different values and interests in society.

Box 5

How will GM foods affect rural sustainability?

Research in Europe, Brazil and the Caribbean has led Terry Marsden and colleagues to the conclusion that GM technology will lead to a further round of intensification in the food industry (Marsden and Drummond 1999a and Marsden et al 1999b). If GM crops lead to the reductions in costs in food supply chains that are promised, this will lead to further economies of scale in food enterprises. In other words, the existing 'technological treadmill' intensifies yet further, leading to even greater concentration of production amongst smaller groups of large-scale growers and manufacturers.

GM technologies are thus likely, particularly in the context of the WTO millennium round, to further speed up the structural change in agriculture and food supply, making it more difficult for smaller producers to stay on the land. GM foods could therefore provide another cause of inequality, unemployment and depopulation in rural areas around the world. Many of these structural changes would be irreversible in generational terms.

In addition, if reductions in costs lead to lower costs to the consumer, it is also likely that alternative food supply chains such as those for organic food will be marginalised on the basis of price. The true costs of industrial foods - incorporating all of the social and environmental effects - are not passed on to the consumer: this is also likely to be the case with GM products.

In July 1999, the Government announced that it was setting up two new strategic committees on GM food to consider cross-cutting issues: the Human Genetics Commission and the Agriculture and Environment Biotechnology Commission. While these committees, and their anticipated broader membership, are a positive step, many of the assumptions and working practices at the heart of the regulation of GM food remain intact.

Despite recent improvements to the regulatory system, significant short-comings remain

This means that many shortcomings remain, including:

- How individual aspects of risk are characterised and measured - for example, what assumptions are adopted about operating environments, working practices and regulatory compliance? Assumptions about pollen distribution and the size of 'buffer zones' is one example of a current controversial issue.
- The implicit priorities adopted in comparing different aspects of risk - how are health aspects compared to environmental effects, involuntary versus voluntary risks, or risks to different groups of people? How are issues of geographical scope and time horizons dealt with? (see box 7 overleaf)
- The treatment of deep uncertainties and 'ignorance' about the possibility of entirely unforeseen effects.

Is GM food needed to feed the world?

Box 6

There are strongly varying opinions about the contribution that GM foods will make to addressing the food needs of the poor and the global demand for food more generally. As Barbara Adam writes: 'Like previous technological innovations, it holds out the promise of cornucopia: the end to food shortages and world hunger, poverty and disease, weather and season dependence' (Adam 1998).

At present there is a lack of conclusive data about GM crop yields. Several recent official US studies have pointed to variability of yields across different crops and regions. It is therefore difficult at this stage to form a solid conclusion about the contribution that GM crops might make to increasing world food production. Terry Marsden suspects that while GM food technologies may increase the quantity of foods available, and in some cases might improve the quality in relative terms, they will not reduce food poverty and scarcity. Indeed, he expects the current uneven development of food production and consumption to intensify both between the North and South and within each region. The issue is less about food production and more about food distribution.

Tim Dyson, in a Fellowship that examined the trends in global food production and consumption, came to the conclusion that world population growth is not outpacing food production (Dyson 1994,1996). However, it is not going to be easy to raise agricultural production to meet world population growth, so while the world could probably feed itself without GM foods, they will nevertheless help.

He found that GM food is already helping to feed the poor. Sizeable areas of land in sub-Saharan Africa are planted with rice varieties that have been made more resistant to blight through the application of GM techniques. Similar approaches could be applied to problems of drought resistance, to salt tolerance, to some crop diseases and to addressing vitamin deficiencies.

However, clearly the interests of the big GM companies are in making profits from farmers who can pay. So the task of developing 'better' GM crops for poor farmers will fall mainly to scientists working in international food research stations and universities. Yet international investment in developing country agricultural research has been declining. Aid could therefore usefully be channelled to supporting pro-poor GM technology development, while at the same time linking this to a wider vision for sustainable agriculture, poverty elimination and sustainable livelihoods.

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The GM time machine

A time-based perspective can give useful insights into the logic behind, but also the potential hazardous effects of, genetic engineering.This is the conclusion of a Fellowship undertaken by Barbara Adam as part of the Global Environmental Change Programme.

In industrial systems, time is money: speed is tied to efficiency because of competition and the need for returns on investments.The control and compression of time is central to the creation of profit. By contrast, in nature everything has its own time, rhythm and season.This natural time is a barrier to productivity and profit (Adam 1998).

GM food technology represents a powerful new way of controlling time in agricultural production. It promises:

- instantaneous reproductive change where before this had to be achieved from one generation to the next
- speeding up of ripening and maturing processes
- control of growth and decay for just-in-time production, retailing and consumption
- increased profits for a few companies through control over the resources of production and reproduction through patenting.

Genetic engineering is only possible because of the shared genetic evolutionary history of all organisms on Earth. This is what makes the transfer of genes from one breed to another possible. And it means that genetic engineering operates in a timescale from the beginning to the end of time.

'The accomplishments, we need to appreciate, are staggering.But,then, so are the perils:millions of years of co-evolution are circumvented.Reproduction cycles are dramatically speeded up or cut out altogether. Here the extraordinary achievement is counterbalanced by the inability to observe when things go wrong and to stop at each of the stages along the way.The achievement thus entails the loss of the established method of trial and error. Although the unprecedented speed-up of processes has obvious economic advantages, it clearly contradicts some very important scientific principles of caution and precaution' (Adam 1998).

Time also sheds light on the politics of GM food.With a five year mandate, politicians only have partial legitimacy to make decisions about issues such as the release of GMOs,since the effects are potentially irreversible and infinite in time. Decisions on GM releases therefore need to be made more legitimate by a strong ethical debate across society, which includes substantial attention to the needs of future generations (Adam 1999).

The achievement thus entails the loss of the established method of trial and error. Although the unprecedented speed-up of processes has obvious economic advantages, it clearly contradicts some very important scientific principles of caution and precaution'

Time to talk

Public debate on genetically modified foods has become highly polarised.Proponents and opponents of the technology each tend to dismiss the other as unreasonable or irresponsible. Some groups have set out to establish a less partisan perspective by involving a range of people with different viewpoints and working towards consensus. But even these have often ended up having their messages 'spun' to one extreme or other. This has either been done deliberately by the sponsoring organisations or through partial reading by the media or politicians.

Environmental social science offers positive ways forward.These are on two fronts:

- What do we need to do on the specific issue of GM to restore a discussion in which all parties to the debate can have confidence?
- What can be learned more generally for the future governance of new technologies?

At this stage there can be no definitive answers to such questions. Indeed,a central part of this paper's argument is that definitive answers do not and cannot exist in the face of uncertainty and 'ignorance'. However, the following observations might give some ideas as to a way forward. In particular, we argue that it is time to experiment with new ways of making decisions on issues such as GM food, and that government and the commercial sector will need to create new capacity to run these experiments. In parallel with this, there appears to be a need for a new capability within Government to be a more 'intelligent customer' for the kinds of knowledge and insight that such experiments will generate.

Rescuing the GM debate

It is clear that the Government failed to anticipate the recent controversy over GM food and crops.There must consequently be serious grounds for concern about the advisory system in this area, and it is a good sign that changes are currently being made to this system.However, there must still be a serious question over the capacity or willingness of key parts of government to explore the range of adjustments to present advisory practice that recent independent research suggests are now necessary.

Researchers in the Global Environmental Change Programme have elaborated detailed recommendations for the changes that are now needed.These have been put forward in a number of substantive research documents and policy consultation responses,many of which are on the web site www.gecko.ac.uk.The central points are briefly covered here. In summary, Government needs to:

- restore its neutrality in the eyes of the public
- address gaps in the current advisory framework as discussed above
- broaden the intellectual 'problem framings'that shape current scientific advice, in order to address the weaknesses of narrow 'sound science' judgements on risk
- be more attentive to social factors, rather than dismissing public unease as a matter of irrationality and lack of understanding
- explicitly take account of the timescale issue and the related questions of how any potential future costs and liabilities might be handled
- systematically analyse the effects that human judgements, such as those shaping scientific assessments on risks, have on the results of these assessments.

It is not enough that a single 'public interest' representative be admitted to serve on an expert committee

The existing system for gathering specialist scientific opinion should be complemented by a process for analysing the subjective framing assumptions that underpin risk assessments (see box 8). It is not enough that a single lay member or 'public interest' representative be admitted to serve on an expert committee. There seems little reason to believe that the particular interests and values of such an individual will offer any more reliable or complete a reflection of perspectives in wider society than would those of the individual experts currently involved. The need is rather for the systematic provision of auditable information concerning the full diversity of interests and values which characterise the different interested and affected parties.

As the Royal Commission on Environmental Pollution argued in its 21st Report, there is no shortage of techniques and procedures by which such information might be gathered, interpreted and verified (RCEP 1998). Consensus conferences, citizens' juries, focus groups and deliberative polls are all relatively well established in other countries in the regulatory appraisal of technological risks (see box 9).

Box 8

The feast of the assumptions

By aspiring to a single definitive 'sound scientific' result, orthodox risk assessments fail to address the degree to which the resulting picture may be sensitive to crucial subjective 'framing assumptions'. Andy Stirling, working with Sue Mayer, is analysing the effects of people's assumptions and values on how they judge GM strategies against other options. By using a technique called multi-criteria mapping, he has shown that people's different but equally reasonable starting assumptions can overwhelmingly affect the outcome of their analysis.

Dr Stirling asked twelve leading players from all sides of the GM debate to list all of the criteria against which they would wish to judge GM crops and other alternatives. The 117 criteria that emerged included factors such as the use of chemicals, impacts on wildlife, human health and cost to consumers. The participants were then able to assign scores to all of their criteria, and weights to reflect the relative importance of the different criteria. They were also asked to give a measure of how uncertain or variable they felt matters to be by assigning both an optimistic and pessimistic score.

Participants in this 'multi-criteria mapping' process are entirely able to express what is important to them and to assign weightings accordingly. They are also able to go back and adjust these in the light of results - they are in the driving seat at all times. However, when confronted with the outcomes of their analysis, remarkably, no one wanted to seriously amend the criteria or scores or weights they initially selected, so the technique seemed to be producing a robust reflection of people's evaluations.

The full results are described in a recent publication (Stirling and Mayer 1999), but the most significant finding was that the final results are most strongly influenced by each participant's early framing of the debate - their selection of criteria - rather than the scores or weightings assigned later. This finding stresses the importance of ensuring that the entire spectrum of values and interests are represented. Yet many criteria chosen by the participants in this study lie outside the scope of official risk assessments. For no participant is their whole range of criteria explicitly considered in the formal evaluation of GM crops in the UK.

Multi-criteria mapping provides a systematic and transparent tool for exploring assumptions in judgements about issues such as GM crops and the alternatives. It does so in a way which directly addresses the practical business of choosing between policy options. By being simple and open it builds trust among participants. It fully acknowledges uncertainties. It can include a wider range of issues than orthodox risk assessments. And it can be applied in a wide range of situations and social groups. In all these ways and more it can be an aid to deliberation and reasoned judgement.

These and other techniques have all been tested on an experimental scale in the UK. Techniques such as multi-criteria appraisal and 'sensitivity mapping' offer ways of combining quantitative and qualitative factors in appraisal,rendering more transparent the framing of scientific advice and providing an 'audit trail' as robust as any in traditional risk assessment. Global Environmental Change Programme and other research has found that some of these approaches hold promise as a complement to the present UK system of advisory committees.These methods can assist in bringing to light the different ways of interpreting scientific advice in the regulation of risks such as those of GM foods.

Government needs to be a more 'intelligent customer' for a wider range of advice. This involves specifying the criteria used to assess the quality of that advice. A provisional set of simple quality criteria for the regulatory appraisal of GM food are emerging from the ESRC's research.As formulated in a recent report by Andy Stirling to the EU Forward Studies Unit, these criteria suggest that Government should,among other things:

Government needs to be a more 'intelligent customer' for a wider range of advice

- Broaden the scope of regulatory appraisal to address social benefits and include synergistic, cumulative and indirect effects.
- Conduct assessments on a comparative rather than a case-by-case basis,including for instance account of a variety of agricultural strategies.
- Maintain a culture of humility and pluralism in the face of the many sources of uncertainty and ignorance in the appraisal of GM foods and other agricultural strategies.
- Provide for iteration and open-endedness in the interactions between sustained scientific monitoring, continued analysis and inclusive deliberation in appraisal.
- Uphold the primacy of institutional legitimacy and political accountability in the final justification of regulatory decisions.

Capturing values: inclusive decisions

Box 9

A series of ESRC-funded meetings is exploring the use of Deliberative and Inclusionary Processes (DIPs) in decision-making on contentious issues such as GM foods.These techniques include:

The focus group is the origin of much of the DIPs style of inquiry. Focus groups typically consists of 6-10 individuals.A trained facilitator takes the group through a number of set questions around an issue, while maintaining an informality to the proceedings.The group discusses these, but there is no need to decide upon the issue, or recommend actions.The purpose is to record and analyse the discussions to reveal people's main concerns.

Citizens' juries are an in-depth process where a selected group evaluate decision alternatives. 12-25 participants are chosen, usually to be representative of the local community.The method follows a jury model. Citizens hear evidence that supports different policy options,and make a judgement at the end of the process. A majority vote is used to resolve conflicts, as the juries must eventually come to a decision (although not necessarily a consensus). Jurors can challenge the claims put forward by witnesses.These can be experts,scientists, local authority officers, politicians, pressure groups, business managers, and indeed members of the public with relevant knowledge. The potential for challenging witnesses offers the chance for creating new policy options.

Other techniques include in-depth groups (like longer term focus groups), consensus conferences (larger citizens juries often used by governments to guage opinions about an issue), stakeholder decision analysis (combines quantitative multi-criteria and qualitative techniques) and deliberative polling (where members of the public are briefed on an issue and then interviewed as part of a survey).

DIPs represent more a style of decision making than a methodological set of rules.The central aim of all the methods is to capture value through the creation of small public spaces, where people can discuss particular subjects, both with each other and with decision makers (Bhattachary 1998).

A vision for agriculture

Two Government Ministers have recently acknowledged that the Government is not in the driving seat with respect to GMOs, but is having to react to commercial developments in the technology (see Environmental Audit Committee report, paras 290-299). While Food Minister, Jeff Rooker stated publicly on several occasions that there is no need for GM crops. In order to have a genuine debate about the future adoption of GM food technologies, the range of options must include the possibility of deciding not to go ahead with adopting the technology, as well as different strategies for adopting GM foods. At present, the list of options seems too narrowly focused.

Terry Marsden concludes that what is needed is a vision for agriculture, and the place of GM within that (Marsden 1999c).There is a growing consensus that conventional agriculture is unsustainable, particularly as a result of policies such as the EU's Common Agricultural Policy. Does it therefore make sense to assess new GM technologies in comparison with conventional agriculture, or can we be more open and forward-looking in thinking about the place of GM foods in our agricultural futures?

A genuine debate would include at least the possibility of deciding not to go ahead with a new technology

Growing food consciousness and food politics are beginning to assert different demands on the food supply. 'Economies of scope' rather than scale are becoming more important, whereby producers and rural regions offer mixed agricultural and rural development products and services, rather than continuing with monocultural agricultures.

The onset of GMs raises the need urgently to develop better and more practical ways forward for producers in achieving new 'economies of scope', which represents a more 'orchestral' rather than mono-functional approach to the countryside. This requires governments to apply integrated approaches to rural policy, aiming for sustained and sustainable employment, environmental protection, nature conservation, and rural communities. But food retailers must also adopt this wider sustainability challenge as one of their core aims. Food retailers now play a central role in regulating the food industry, mediating and creating consumers' demands for foods, and setting food quality standards (Marsden 1999b).Retailers can therefore play a powerful role, in partnership with government,in integrating rural sustainability in its policies and practices.

Government also needs to address the needs of developing countries in setting out its vision for agriculture and the place for biotechnology in this vision.In its White Paper on International Development, the UK government committed itself to supporting strategies that eliminate poverty and encourage sustainable livelihoods among the world's poor. Some believe that GM crops are an important route to this end. Others, by contrast, argue that, given the concentration of biotechnology R&D expertise in a few private corporations, the chances of the 'gene revolution' having much impact on poverty is remote (Scoones and Newell 1999).

Governments should assess the benefits envisaged for GM strategies - it has been no-one's job to do this so far

But how should UK support to developing countries address the GM issue, given the potentials and dangers of GM technology? Just as in the UK and Europe, the principles for successful regulatory policy outlined above also apply in the developing world. But in such settings, where regulation is weak,and different scientific and political contexts apply, the process for arriving at a vision will certainly be different. Building on Global Environmental Change Programme research,new work at the Institute for Development Studies will be looking at these issues in developing countries, asking how a pro-poor approach can be ensured.

A body of social research suggests that Government should therefore undertake a broad analysis of the benefits envisaged for GM strategies - it has been no-one's job to do this so far - as well as a frank assessment of the known risks and the uncertainties attached to GM technologies.The debate would be greatly enhanced if Government then articulated how these benefits and risks fit with its vision for the countryside and the food system.

Future governance of new technologies

The development of GMOs is just one of many technological innovations that will require careful handling by governments in coming years. Governments and others need to learn the lessons from the current difficulties with GM foods.They need to adopt a precautionary approach, some of the implications of which are now becoming clear (see box 10).

Science is an essential engine of social progress.It produces much of the knowledge and technologies on which we all rely and the luxuries that many enjoy. Not only does it help to identify social and environmental problems, but frequently it is vital in helping to solve them also. As has been suggested, scientific monitoring of the effects of new technologies needs to be maintained and enhanced.But even with thorough monitoring, science is a necessary but not sufficient basis for government decisions.The issue is the use of science and scientific advice.

As advisors to Ministers, scientists often come under great pressure to reach unambiguous judgements about the safety of new technologies such as GM foods.This means that they find it difficult to justify precautionary advice due to the lack of evidence to back it up. The onus of proof tends to fall on those that fear negative effects.By contrast,justice systems around the world are beginning to develop various precautionary ways of dealing with uncertainty (see box 11).

Six rules for a precautionary world

Box 10

Tim O'Riordan has identified the following rules for precautionary action:

1 Where unambiguous scientific proof of cause and effect is not available, it is necessary to act with a duty of care

2 Where the benefits of early action are judged to be greater than the likely costs of delay, it is appropriate to take a lead and to inform society why such action is being taken

3 Where there is the possibility of irreversible damage to natural life support functions, precautionary action should be taken irrespective of the foregone benefits

4 Always listen to calls for a change of course, incorporate representatives of such calls into deliberative forums, and maintain transparency throughout

5 Never shy away from publicity and never try to suppress information, however unpalatable. In the age of the internet, someone is bound to find out if information is being distorted or hidden.

6 Where there is public unease, act decisively to respond to that unease by introducing extensive discussions and deliberative techniques.

We have already seen how decisions on such issues cannot rely on 'sound science' alone to produce definitive judgements about safety. Subjective and ethical factors underpin many debates about risk. O'Riordan suggests that in order to address these factors, and in the context of 'ignorance', the only way forward is by stages agreed mutually by a greatly expanded set of participants in the decision-making process.Each stage is dependent on what happens immediately before.

However, due to 'ignorance'(see figure 1), even such a participatory decision-making process will itself also be imperfect.There is a constant need for review of the results and learning about the process, particularly at the early stages.Even such participatory processes will therefore be unlikely to deliver to expectations:there are no easy answers in the face of profound uncertainty.

Research within the Global Environmental Change Programme has developed decision tools that can help in such situations. In particular, the multi-criteria mapping approach developed by Andy Stirling combines the systematic and transparent character of quantitative techniques, with the breadth of scope and pluralism of participatory deliberation (Stirling 1999 and see box 8).

O'Riordan also finds support for a form of scientific risk management based on the ethical norm that those least able to defend themselves should be protected by greater use of precautionary approaches. However, he acknowledges that this is a tricky area, for it explicitly places science in the frame of more judgmental processes of risk assessment. Again, dialogue plays an important role.

Box 11

Proving causation - shifting the burden

The justice system is the final arbiter of social conflict, and must evolve to meet the challenges of scientific uncertainty. Adverse impacts from new technologies are hard to prove, and perpetrators often escape responsibility. Chris Williams (1997) points out that traditionally the burden of proof is put on those who suffer harm, but now technologically advanced countries like Germany are beginning to shift the onus of proof. Put simply, if an industry has released an environmental agent that is not safe, it is for the industry to prove that it was not the cause of any possible adverse impact.

Traditional burden of proof	Revised burden of proof
Those who suffer must prove:	Those who suffer must prove:
- an adverse impact occurred	- an adverse impact occurred
- the environmental agent can cause the impact	- the environmental agent can cause the impact
- the environmental agent was released	- the environmental agent was released
	Causation is proven unless those who released the agent can show that:
- the victim was exposed to the agent	- the victim was not exposed to the agent
- the level of exposure could cause the injury	- the level of exposure could not cause the injury
- there was no other cause	- there was another wholly responsible cause

This may seem a radical change of the 'innocent until proven guilty' maxim, but is already accepted in other circumstances.Under UK law, if your car is stolen and you claim that the thief damaged it, the thief must now prove otherwise to avoid liability.The act of the perpetrator makes it difficult for the victim to prove causation,so it is morally acceptable to switch the burden of proof.Applying this principle to environmental causation would reduce the inclination for industries to 'chance it'. Responsible industries should welcome this change - it levels the playing field between them and less scrupulous rivals.

However, despite the evident difficulties, O'Riordan detects signs of this approach being put into practice through a more open and precautionary interpretation of scientific advice in the UK, citing the decisions to ban beef on the bone and to remove blood plasma from sources just conceivably infected by nv CJD. He suggests that the approach should be followed in cases where the risk is:

- involuntary at the point of impact
- unavoidable - individual freedom of choice to avoid the risk is not possible, or not guaranteed
- likely to hurt those most removed from the cause, and least knowledgeable of the possible consequences
- societal in scope rather than restricted to a clearly defined group of people.

Social science research has shown that people search for certainties when forming outlooks on new threats or opportunities (Tansey and O'Riordan, 1999). Such certainties are influenced by the social networks which individuals use to guide their opinions and judgements. Trust and faith are also determined in this way. What we are just beginning to realise is that there are many 'publics' in society, and that any given individual may move in and out of a number of bonding groups. The lesson here is that many messages are needed to help different cultural solidarities come to terms with GM futures. This is one of the many challenges ahead.

Some parties to the GM food debate are taking very seriously the need to gather better social intelligence on public opinion. They are doing so through new alliances of apparently unusual partners that can usefully work together on complex social issues such as those embodied in the GM debate (see box 12).

New alliances for social intelligence

Box 12

It is not just the insights from environmental social science that have been original and incisive in the GM area. Several researchers have also been involved in ground-breaking styles of research - collaborations with firms, environmental groups and governmental bodies to achieve better insights into the core policy issues.

Dr Andrew Stirling of SPRU (Science & Technology Policy Research, University of Sussex), has been working with the consumer products firm Unilever, the lobby group Genewatch, and a number of environmental and consumer groups to find out the core assumptions and values that inform the regulation of GMOs in the UK. This work has built on his Fellowship in the Global Environmental Change Programme. The CSEC report Uncertain World was produced in a similar arrangement (see box 1). Moreover, a follow-up report by the same Lancaster team with the working title On Information and the Citizen: Lessons from the GM Crisis has been produced within the same partnership arrangement, and is due for publication in late 1999.

Unilever is an example of a firm giving early recognition to the deficiencies in governmental approaches to the regulation of a new technology. Despite being in favour of biotechnology in principle, Unilever withdrew in 1999 from the marketing of GM products in the UK. Given the favourable general attitude to biotechnology in the firm, the withdrawal must have been due to the harm that Unilever perceived could be inflicted on its 'brands'. Brands are products which have been built up over many years of advertising and market research to embody qualities of reliability, convenience and value for money - in short, consumers trust them. Unilever's perception is probably that the inadequacies of the regulation of GM products mean that this trust could easily be lost, regardless of the care taken over individual products.

By funding research such as that at SPRU and CSEC, Unilever has been at the forefront of gathering social intelligence in novel ways to inform its corporate strategies. Such alliances are good examples of partnerships that can promote genuine learning in the face of a socially complex challenge.

The challenges ahead

Perhaps the greatest challenge of all is the need to open up the policy processes surrounding new technologies to far greater interaction with members of the public and their diverse values.This would involve opening decision-making to genuine participatory methods, while maintaining a central place for scientific information and analysis as it emerges. So far, there has been an unwillingness to adopt more participatory approaches to technological innovation.Where experiments have been conducted, such as the consensus conference on biotechnology in 1997, the lessons have been inadequately incorporated by the other parts of government.

Inclusive deliberation requires a set of conditions that are hard to live up to. Underlying commitments include:

- that elected politicians agree to share power. In so doing,politicians should actually enhance their power finally to act. But that assumption is speculative in an uncertain new patterning of democracy, so most politicians remain deeply sceptical about real community democracy
- that regulatory and executive agencies become more transparent, both in their decision-making and in their provision of information
- that participants accept responsibilities to reach agreement.

So a crucial issue is whether the social insights to emerge from inclusive procedures, such as citizens' juries and consensus conferences,will be treated seriously by those in power. How will they be related to other arrangements for scientific debate such as advisory committees, specialist panels and technology assessments?

Participatory methods of public engagement are intrinsically open-ended. In the presence of profound uncertainties and 'ignorance', they will also remain imperfect. However, this document has argued that such methods allow a wider range of factors to be taken into account. Because of this, decisions are likely to be more legitimate than those based purely on 'sound science'as currently defined.

Finally, in acknowledging these imperfections, Government needs to develop its ability to discriminate and filter new technologies.The GM debate has been so controversial not least because of the deep cultural significance of food and the changes that genetic engineering promises to bring culturally and socially. Our evidence shows that many people are increasingly unwilling simply to accept such revolutionary changes without a genuine debate about the options society faces.

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About this document

This document is a synthesis of the work of the above contributors (see references). All of the contributors gave generous help, including their comments on several drafts. The document was written and edited primarily by Alister Scott, with particular assistance from Frans Berkhout and Ian Scoones.

Further sources written by the contributors

In an attempt to underpin this summary Briefing paper with other more substantial material, those of the following sources marked (W) are available on the web site www.gecko.ac.uk. Those marked w are summarised on the web site.

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Information

The Global Environmental Change Programme is in its final year. Supported by the Economic and Social Research Council, the Programme has run since 1991 and will end in June 2000. It has supported 150 empirical research projects, Fellowships and PhD studentships across the UK including all the contributors to this briefing.

In the final year, the main priority is to ensure that the greatest possible benefit is derived from this research investment. We will be engaging decision-makers from a range of organisations in discussions based around the findings from the Programme's research, as well as disseminating the findings more widely. These discussions will be based around three topics:

- decision-making under environmental uncertainty
- governance of the global environment
- sustainable production and consumption

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Special Briefing No 5

The politics of GM food

Risk, science and public trust

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