GM crops? : coexistence and liability / a report by the Agriculture and Environment Biotechnology Commission.

GM CROPS?
Coexistence and Liability

A REPORT BY THE AGRICULTURE AND ENVIRONMENT BIOTECHNOLOGY COMMISSION

November 2003

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EXECUTIVE SUMMARY

1. Government is considering its policy on the possible commercial growing of genetically modified (GM) crops in the UK. It is doing so within a framework of European law and international trade obligations. Ministers have before them a range of evidence, including the results from the Farm Scale Evaluations (FSEs) and from the public debate, science review and study on the costs and benefits of GM crops.

2. Maize, oilseed rape and beet are likely to be the initial GM crops proposed for commercial cultivation in the UK. These crops have each been genetically modified to be tolerant to a specific herbicide. However, decisions will be needed in the future on the commercial release of other crops. They may be genetically modified to have, for example, disease resistance, specific nutritional qualities, or greater suitability for non-food industrial uses. A number of these are already being grown abroad and others are currently under development. We focus in this report primarily on herbicide tolerant GM crops but have taken into account possible future developments.

3. Agricultural policy in the UK and EU is now focused upon reconnecting farmers with consumer and market demand, and encouraging more sustainable farming practices, although there can be tensions in practice in trying to achieve both these general aims.

4. We make no assumption that commercial growing of GM crops in the UK will necessarily proceed. Rather we have looked at some key issues raised by the prospect of commercial production. How could conventional and organic farming be reconciled with giving farmers freedom to choose to grow GM? How could domestic consumer choice be maintained – that is, would consumers be able to continue to purchase non-GM or organic products produced in the UK? These are the questions at the heart of the coexistence debate. Permits for commercial growing of GM crops are granted on a Europe-wide basis, but EU law allows individual member states to make their own arrangements to promote coexistence.

5. There is also a closely related question of economic redress. There are tolerance thresholds for unavoidable (adventitious) presence of GM material in non-GM crops or produce. In considering these we recognise that no harvested crop can avoid containing low levels of foreign material, such as other crops, weed seeds and insect parts. GM thresholds are specified in law or in organic or other commercial standards. If a product contains GM material above the legal threshold of 0.9% it must be labelled as containing GM. At any threshold a non-GM crop might fail to meet a particular commercial requirement. The crop might consequently fetch a lower price and the farmer suffer loss of income. Who would or should be responsible for such loss?

6. Under EU law, the use of GMOs by organic farmers is forbidden: they are not allowed to market crops or foods as organic if they have been produced using GMOs. No legal threshold has been set for adventitious presence in organic produce, although there is provision in EU law to do so. The Soil Association, which has taken a public lead on the issue among the UK organic certification bodies, has gone further than this requirement and further than the 0.9% threshold.

7. It is working to its own 'zero' threshold for adventitious presence in organic produce, translating this into a de facto threshold of 0.1%, as the practical limit of detection with a reasonable size of sample. If found to be above 0.1%, an organic crop could have its organic status removed by the Soil Association or other organic certifying body working to this lower threshold, although this is not required in law. Accurate testing to the level of 0.1% on the farm would be very challenging.

8. Government policy is to promote the sustainable development of the UK organic farming sector in line with consumer demand. At present little organic maize, oilseed rape or beet is grown in the United Kingdom, so the risks from adventitious presence to organic farming may be restricted initially and any direct financial losses small. But this could change in the future if more of these crops were grown organically or, perhaps more likely, if GM varieties of crops more important to the organic market were made available.

9. The present policy of major UK retailers is to avoid GM ingredients in their own-label food products, and often in animal feed, in response to perceived consumer demand. If this policy continues, some non-GM, as well as organic farmers might also be aiming to keep to thresholds as low as practicable, possibly down to 0.1%. For non-food crops the situation differs; the customer may for example be an industrial fuel or lubricant producer, not a supermarket or food processor.

Recommendation 1: The main aim of Government policy on coexistence of GM and other crops must be to facilitate consumer choice to the greatest possible extent, while allowing UK farmers to respond to present and future national and international market demand.

10. We are confident that a *laissez faire* approach to growing GM crops would be much less likely to achieve coexistence than having rules in place. So against the present background of consumer attitudes and market conditions, if GM crops are grown commercially it must be in accordance with crop management protocols. Legally binding protocols would require authority in statutory legislation to establish the regulatory framework. However, the scheme should be flexible enough to ensure that the detailed measures in protocols could be varied in the light of new evidence without having to revise the legislation. This suggests an approach modelled on a binding code of practice.

11. Farmers growing non-GM or organic crops, particularly to lower thresholds than 0.9%, would also need to take measures to minimise adventitious presence of GM material in their crops, for example by controlling volunteer plants carefully and cleaning machinery before harvesting crops.

12. We all agree that that there should be legally enforceable crop management protocols, although for some of us only if making the necessary legal arrangements did not cause significant further delay in GM crops being made available for growing.

Recommendation 2: If GM crops were to be grown commercially, farmers growing them should be required to follow legally enforceable crop management protocols designed to achieve at least the 0.9% threshold.

13. We were unable to agree on how coexistence arrangements should be arranged to try to deliver an adventitious presence threshold of 0.1% for organic and any other farmers who wish to work to a non-statutory threshold.

14. There are a number of different perspectives. First, that coexistence arrangements must deliver 0.1% and growing GM crops should be constrained as required to achieve that. On this view, organic producers are responding to consumer demand for as little GM material as possible in their food, so 0.1% is a realistic and reasonable threshold to set. The onus should therefore be on GM cropping to take place, if it takes place at all, in a way that respects the 0.1% standard widely adopted in organic agriculture and, moreover, that allows non-GM farmers to work to a similarly low threshold.

15. Second, a view that strongly suspects on the basis of the available evidence that successful coexistence at 0.1% would be unachievable if there were significant areas of GM crop cultivation, and so opposes setting up coexistence arrangements to aim to achieve 0.1% because that would raise unrealistic public expectations about what is likely to be deliverable. In addition, some of us think that as a matter of principle it is unreasonable to require GM growers to comply with a lower threshold than the statutory one ratified at EU level, and that it should be the responsibility of the grower who is producing to a lower threshold, and who attracts a premium for its delivery, to achieve that standard. And there is a fear that setting a threshold of 0.1% seriously threatens progress in developing this and possibly other new technologies in farming which promise consumer, environmental and other benefits.

16. For coexistence to be successful, breaches of thresholds would need to be rare. But there is considerable uncertainty about what the cumulative effects of the different sources of adventitious presence might amount to in commercial production at different levels of growing GM and other compatible crops, and what threshold levels could actually be delivered in practice using crop management protocols.

17. The possibility and extent of negative economic impacts on non-GM and organic farmers are also uncertain. We believe that, if GM crops were commercially grown, there should be an initial period of a few years where particular care would be taken in auditing and monitoring coexistence arrangements. Precaution should continue therefore to be the basis of Government policy-making, based on all the evidence available.

18. The concern that 0.1% may be unachievable in practice if GM crop cultivation became widespread is shared by all members of the Commission. Consistent with this, we all agree that it will be necessary to investigate whether and to what extent the 0.9% and 0.1% thresholds are achievable in practice on the farm, and what levels of adventitious presence are being found in non-GM and organic final products. The data-gathering in the initial period should be designed to allow Government, farmers and producers in all sectors, and the public, to assess whether coexistence arrangements are meeting the goals set for them, what is realistically deliverable in commercial production, and what this means for policy on growing GM and other crops in the UK.

Recommendation 3: If GM crops are commercialised, there should be an initial introductory period where there would be intensive monitoring and auditing of coexistence arrangements to determine whether and how far coexistence was actually being achieved.

Recommendation 4: The powers to impose coexistence protocols should allow for their ready amendment if data gathered in the introductory period showed that coexistence and the delivery of consumer choice was not being achieved

and Government should be able, if necessary, to suspend production of a GM crop unless and until arrangements were made to overcome coexistence problems.

19. In addition, several members would strongly prefer there to be a statutory annually reviewable limit on the area of GM cropping or on the amount of GM seed sold in the initial period. There might well be difficulty in reconciling compulsory limits with EU law, where they might be characterised as arbitrary interference with trade. However, voluntary agreement between industry and Government would not fall foul of EU law and could well be achievable. In addition, some of our members think that a compulsory limit on GM take-up in this period would risk unfairly denying some farmers access to GM crops and that market forces should determine the rate of adoption, which would initially most likely be modest.

20. Our views on where the burden of responsibility should lie for taking some of the crop management measures necessary to test coexistence arrangements in the initial period, particularly following recommended separation distances for 0.1% in addition to 0.9%, vary according to our views on the reasonableness or otherwise of GM growers working to a non-statutory threshold.

21. The most promising models for overseeing management of coexistence arrangements would seem to be either: (1) entrusting to a representative group of stakeholders the function of overseeing implementation by the agricultural biotechnology and farming industries; or (2) a Government-led scheme.

22. We all agree that there should be access to compensation for farmers who suffer financial loss as a result of their produce exceeding statutory thresholds through no fault of their own. In principle insurance would be the best means of financial redress, but cover is unavailable at present, and there would remain the question of who should be responsible for paying insurance premiums. Monitoring during an introductory period of cultivation should help an insurance market develop by providing data by which insurance companies could assess risk. We do not envisage a special compensation scheme would be permanent. Government will wish to promote the development of an insurance market.

23. The principal possible providers of compensation in the absence of insurance cover would be Government; agricultural biotechnology companies holding GM consents; consent-holders and other parts of the agricultural supply industry, or a combination of Government and industry; or all farmers through a small levy on harvested crops.

Recommendation 5: There should be special arrangements for compensation for farmers suffering financial loss as a result of their produce exceeding statutory thresholds through no fault of their own, with a view to an insurance market developing in due course.

24. As with the design of coexistence arrangements in relation to 0.1%, we are divided on the issue of compensation for farmers not just where the 0.9% threshold is exceeded, but also to a 0.1% threshold. Among those of us who take the view that compensation to a 0.1% threshold is essential, the weight of opinion is towards GM consent-holders and/or Government funding compensation rather than farmers through a levy on harvested crops. On the other side of the debate, the position is that it would be unreasonable to expect compensation from any source other than the organic sector because the threshold is self-imposed rather than statutory.

25. We have also considered the equally important issue of environmental liability. The regulatory process provides powerful safeguards against the prospect of harm being caused to the environment, but as with any other regulated activity it is necessary to ask who would be responsible in the event of harm actually occurring.

26. Procedures are now at an advanced stage in the EU for the adoption of a Directive on environmental liability generally, and the draft Directive explicitly extends to GMOs. The draft Directive follows an administrative liability model and is based on the 'polluter pays' principle. Should environmental damage occur, the competent authority of a Member State would have the right to undertake remediation, and to take proceedings against the responsible operator to recover the cost. The draft Directive provides a platform upon which Government should develop the existing UK administrative liability regime for GM crops.

Recommendation 6: Government should use the general approach of the draft EU Environmental Liability Directive to develop the UK's liability regime for any damage caused by the release of GMOs to the environment.

27. Under the existing UK regime, the regulatory authority must first secure a criminal conviction from the party that has caused the environmental damage in question before being able to require remediation. This formal precondition is out of line, both with other UK environmental liability regimes and with the draft Directive, and should be repealed.

Recommendation 7: The Environmental Protection Act 1990 should be amended to allow the competent regulatory authority to require environmental remediation where reasonable and appropriate in respect of environmental harm caused by the release of GMOs, irrespective of criminal liability.

28. Within the framework envisaged by the draft Directive, a regulatory authority would be empowered to determine in the first instance whether unwanted environmental effects from GMOs constituted environmental damage, and would be best placed to decide what ought to be done and who should pay, taking account of the impacts of all kinds of crop-growing and wider considerations of public policy.

29. In order to secure adequate assurance now, the Environmental Protection Act should be amended in advance of the transposition of the anticipated Directive to follow the model of other statutory environmental regimes in conferring power on the regulator to require a GM crop consent-holder or other responsible party who can be shown to have caused the damage to carry out specific works of remediation, or to contribute to the regulator's own costs in carrying out those works itself. The normal safeguards against unfair use of such discretionary powers, particularly judicial review, would remain available and might be complemented by a right of administrative appeal.

30. Some of us would emphasise that environmental impacts might be irreversible and impossible to remediate (though the likelihood of this occurring is contested among us) and would wish to see a requirement imposed on the agricultural biotechnology industry to contribute to a fund to cover any future environmental costs, to avoid any possibility of Government and thus the tax-payer financing these in the event that the costs could not be otherwise recovered.

Recommendation 8: the Environmental Protection Act 1990 should be further amended, reflecting the regime envisaged by the draft Directive. The means of

dealing with any environmental effects from the release of GMOs, including diffuse effects, should be the responsibility of the competent regulatory authority, who will have a number of options at their disposal, including requiring remediation.

31. Any commercial production of GM crops must, we are all agreed, go with the grain of the future direction for farming: reconnecting farmers to the national and international marketplace and a strong shift in the direction of enhancing the farmland environment. The same goes for conventional crops.

Recommendation 9: Active consideration should be given to the development of protocols for positive environmental management of the cultivation of GM and other crops, to operate alongside coexistence protocols.

32. Adequate monitoring of the environmental impacts of growing GM crops, as required in the Deliberate Release Directive, would be essential. In addition to looking for any effects specific to particular GM crops, as required by the Directive, there should be adequate general surveillance of the longer term and larger scale impacts of growing GM crops and equally of other crops, with the aim of helping support environmentally sympathetic farming practices.

PART 1 CONTEXT AND SCOPE

The scope of this report

1. Government[1] is developing its policy on the possible commercial growing of genetically modified (GM) crops in the UK. New European legislation which should end the *de facto* moratorium in the EU on approving new GM crops and foods is now in place. The Agriculture and Environment Biotechnology Commission (AEBC) has considered the key issues of coexistence and liability raised by the possible commercial production of GM crops. In doing so, we should point out that we have not assumed that commercial growing will inevitably go ahead.

2. We have in particular looked at whether it would be practicable for the commercial production of GM crops to coexist with existing conventional[2] and organic systems of agricultural production in a way that secures continuing real choice to consumers. Could practicable measures be devised and implemented to ensure that different sorts of farming can coexist, with domestic agriculture continuing to offer consumers the present choice of conventional and organic products alongside GM products? Could and should arrangements be made to compensate farmers who might suffer economic loss if and when coexistence measures did not work? Who if anyone could or should be held liable for any such loss?

3. We have considered the equally important issue of what would happen if the commercial production of GM crops turned out to have a damaging impact on the environment. Who would be held liable for putting any damage right, and how? And who would take responsibility in the event of any environmental damage judged to be irreversible? The issue of whether measures to deal with coexistence and liability might lead to loss of opportunities of possible benefit to agriculture and the environment from growing GM crops has also regularly been raised in our discussions.

4. We begin with the context for consideration of coexistence and liability issues: present trends in public attitudes and UK agriculture policy; and the present regulatory framework for GM crops.

Public attitudes

5. The context in which we (and others) have been considering these issues is highly charged and marked by profound disagreements amongst interested parties and society as a whole. These disagreements encompass views about the novelty, speed of development, and transformative potentials of GM technology and the uncertainties over what its use may bring; the turbulent politics of GM, including now formal action by the United States Government in the World Trade Organisation against the European Union; and the present climate of UK public opinion.

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[1] "Government" here and elsewhere in this report means the UK Government, the Scottish Executive, the Welsh Assembly Government and the administration in Northern Ireland.

[2] In this report, we use the term "conventional" or "non-GM" agriculture to mean farming which does not use GM crops but which is not organic agriculture. We consider organic agriculture separately because of the particular issues it raises in relation to use of GMOs.

6. Reflected in this report are some sharp differences of view among us, as well as some common ground, about aspects of coexistence and liability. AEBC members bring some shared but some different values to bear on the issues; and we do not always arrive at the same result when weighing up the options. This should not be surprising. As the Prime Minister's Strategy Unit (PMSU) noted in their recent analysis of possible scenarios for GM crops in the UK, value judgements and weighting of different factors are required in any assessment of how possible costs and benefits from GM crops should be traded off against one another[3].

7. The latter development of this report has taken place against the background in summer 2003 of *GM Nation?*, a nationwide programme of debate on GM[4]. The survey of existing research into public attitudes to GM issues, conducted in autumn 2002 prior to the period of the debate, indicated among other things that:

> "...Against a background of relatively positive attitudes to science and also to many non-food applications of biotechnology, attitudes to GM food/crops have been largely negative over the last decade. Attitudes are also characterised by ambivalence and uncertainty, largely due to low levels of information and a sense of distrust in the relevant institutions."[5]

8. The substance and tenor of this research was reflected in the PMSU's[6] analysis that public attitudes will be important in determining the future of GM crops and foods in the UK. Their analysis drew on recent opinion poll surveys, which have generally indicated a negative public attitude towards GM food and crops, although with some evidence of ambivalence, and of differentiation between: GM food and GM crops; food, feed and non-food applications of GM; and different GM traits. This was reflected in key messages from the final report from *GM Nation?* which - although not designed as a quantitative opinion poll survey - found that there was a general uneasiness about GM crops and little support for their early commercialisation[7].

9. It seems clear that issues of choice, coexistence, and environmental impacts lie at the heart of much of the public debate in the UK; and that many people are at the very least cautious, for various reasons, about the prospect of growing GM crops on a wide scale. The AEBC is charged particularly with taking into account public attitudes in our considerations in addition to the economic, scientific, legal and international context of developments in relation to GM crops. As noted earlier, this report looks at issues raised by the prospect of GM crop commercialisation in the UK. We all recognise that some people do not want commercial growing to happen in any circumstances. What we have aimed to do is to develop our advice about coexistence and liability, were GM crops to be grown commercially, taking fully into account the present state of public opinion as we see it, while recognising that there

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[3] PMSU report, p.101

[4] See http://www.gmnation.org.uk for the report of the debate (published September 2003).

[5] *Public Attitudes to the Commercialisation of GM Crops: A Report on Desk Research*, John Kelly, December 2002.

[6] Part 2 of the PMSU report, p.29

[7] The G*M Nation?* programme of debate elicited some 37,000 individual responses from people attending around 600 meetings of various kinds around the UK, or visiting the website or otherwise sending in their views. In addition to the 'open' programme of deliberative debate, a series of reconvened 'narrow but deep' discussion workshops took place in parallel in June/July 2003, were held with invited participants who had not before been actively involved in activities for or against GM. Reports of these different activities, the overall report of the debate, and the initial desk research on public attitudes conducted in autumn 2002 may all be viewed at http://www.gmnation.org.uk

is a spectrum of opinion, and allowing for the possibility that public attitudes might change in the future. Freedom for consumers to choose the products they want, whether from conventional, organic or potentially GM agriculture, and concern that such choices might become unavailable, has to be examined in this context. We have approached the question of coexistence of GM and other crops with the issue of consumer choice at the centre of our considerations[8].

10. It should also be kept in mind that agricultural production in the UK is directed not only to local markets but, particularly in the case of commodity crops, also to foreign markets. We understand for instance that an export market has been established for industrial grades of UK oilseed rape and for specific grades of wheat, and a market for linseed is developing. UK farmers will be responding to these markets as well as to the domestic consumer market.

Agricultural policy in the UK and the EU

11. The Policy Commission on the Future of Farming and Food, which reported in January 2002 (the Curry Report)[9], suggested a clear direction for the future of agriculture in England. The report emphasised that farming should reconnect with its markets by responding more appropriately to demand. Because of its inherently higher cost base, the UK cannot generally expect to be competitive in global commodity markets, so it should concentrate on higher quality, higher value-added products in which the UK would find it easier to be competitive[10].

12. However, the report was clear that there was no "one size fits all" solution to the immense challenges facing the industry. While some farmers should benefit from the opportunities presented by an increasing consumer interest in the provenance and quality of food, some would survive by utilising their assets such as land and buildings in more creative ways. There might also be opportunities in non-food crops (for example, biofuels). The devolved administrations carried out their own reviews at approximately the same time, making recommendations with a similar thrust[11].

13. In its strategic response to the Curry Report[12], the UK Government acknowledged that the challenge for the farming industry as a whole was to be flexible, entrepreneurial and close to its markets, suppliers and customers. The Government's overarching aim was to "promote a competitive and efficient farming

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[8] English Nature, in evidence to us (May 2003, following our coexistence stakeholder seminar), argued in addition that environmental factors can be closely related to coexistence measures. There could be biosafety reasons for restricting gene flow, to prevent some instances of gene-stacking in crop or wild plants. Or, for example, greater spraying of conservation headlands to deal with volunteers, as part of coexistence measures, could have an environmental impact. Environmental effects as well as economic impacts need to be considered in developing coexistence measures.

[9] *Farming and Food – a sustainable future.* Report of the Policy Commission on the future of farming & food. January 2002. Chair – Sir Donald Curry. http://www.cabinet-office.gov.uk/farming .

[10] The PMSU report assessed that wider developments in agriculture are likely to be more important to UK agriculture in the short term than GM crops. National and EU policy decisions relating to the (subsidised) market in agricultural produce will have a much greater impact on farmers' incomes.

[11] *Forward Strategy for Scottish Agriculture*, June 2001, which can be viewed at http://www.scotland.gov.uk/library3/agri/fssa.pdf. Similar themes are picked up by the Steering Group set up to develop a vision for the future of the agri-food industry in Northern Ireland, which reported in October 2001, http://www.dardni.gov.uk/publications/pubs0036.htm and in 'Farming for the Future', the Welsh Assembly Government's strategy, http://www.wales.gov.uk/subiagriculture/content/futures/futuresgroup_e.htm

[12] Defra, *The Strategy for Sustainable Farming and Food* for England, incorporating a response to the recommendations of the Curry report. October 2002. http://www.defra.gov.uk/farming/sustain/response

and food sector which protects and enhances our countryside and wider environment, and contributes to the health and prosperity of all our communities". It saw the liberalisation of agricultural trade and the removal of trade-distorting support and protection mechanisms as a driver not only for allowing producers to reconnect with their markets but also for improved environmental standards. The devolved administrations have embarked on action plans to implement their respective strategies for agriculture, with similar themes, taking account of the specific patterns of agriculture in each territory.

14. There has also been a fundamental shift in agricultural policy, both within the EU and the UK, towards environmental protection and enhancement. It has been recognised that the Common Agricultural Policy (CAP) system of production subsidies has led to considerable environmental harm, and has distorted market signals from the consumer to the farmer. UK agriculture was tremendously successful in delivering the huge improvements in efficiency and volume of production asked of it by Government and society following the second world war. However, external costs, for example loss of biodiversity; the devaluation of environmental capital, such as soil quality and quantity, and the more easily calculated costs of, for instance, removing pesticides from water supplies, historically have not often been taken into account in analysing farming's technical and economic successes.

15. A key aim of the reforms of the CAP agreed by European Union agriculture ministers on 26 June 2003[13] is to remove environmentally negative incentives in the current policy and provide further encouragement for more sustainable farming practices. This involves "decoupling" financial support from production: breaking the link between what a farmer produces and the subsidies he or she receives for the vast majority of arable and livestock production. Instead a new 'single farm payment' to the farmer will be conditional on meeting environmental, food safety and animal welfare standards as well as the requirement to keep all farmland in good condition ("cross-compliance"). The different elements of the reform will enter into force in 2004 and 2005. The single farm payment will enter into force in 2005[14].

Policy on GM crops

EU legislation[15]

16. The cultivation of GM crops and their import as commodities has been regulated at EU level since 1990. The relevant legislation for granting permission to sell a new GM crop is now the Deliberate Release Directive 2001[16]. Part C of the Directive

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[13] Decision at the EU Council on Agriculture, Luxembourg, 26 June 2003.

[14] Although Member States have the option to continue linking subsidy to production until 2007, an option France is expected to exercise.

[15] For more details, see Annex A.

[16] Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EC (OJ L106, 17 April 2001). This Directive came into force on 17 October 2002. It replaces the previous Deliberate Release Directive (Council Directive 90/220/EEC of 23 April 1990 on the deliberate release into the environment of genetically modified organisms (OJ L117, 8 May 1990) as amended by Commission Directives 94/15/EC of 15 April 1994 (OJ L103, 22 April 1994) and 97/35/EC of 18 June 1997 (OJ L169, 27 June 1997)). In Scotland, 'The Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002, SSI 2002 No. 541'. In Wales, 'The Genetically Modified Organisms (Deliberate Release) (Wales) Regulations 2002, No. 3188 (W304). In

provides that approval for commercial cultivation can be refused only on grounds of risks to human health or environmental safety. Once a GM variety has received "Part C" approval, it is authorised for use throughout the EU, in line with European single market principles, and in general no individual Member State may prohibit, restrict or impede its use[17]. By 1998, three types of GM maize had already been approved for commercial cultivation[18]. Since then there has been a *de facto* moratorium on the issuing of new consents, as a number of Member States have made it clear that they would oppose them. However, this moratorium has no legal basis, and the US Government in the World Trade Organisation has now formally challenged it.

17. EU legislation currently requires products to be labelled as containing GMOs if they have a GM content of 1% or more. Legislation[19] has now been passed to reduce that threshold to 0.9%, and to extend it to all products produced from GMOs, even if no DNA or protein of GM origin is detectable in the final product (e.g. refined soya, maize and oilseed rape oils).

18. A legal basis for Member States to take national measures to ensure that the production of organic and conventional crops can coexist with GM crops was introduced during the passage of the new GM food and feed and traceability and labelling legislation. "Member States may take appropriate measures to avoid the unintended presence of GMOs in other products."[20] The measures must be consistent with the principles of the single European market. This legal provision has taken the form of an amendment to EC/2001/18[21]. Member States may decide to use either existing or new national legislation to put regulation in place at the national level.

19. There are also proposals to establish legally enforceable standards for GM content in seed described as non-GM. The thresholds under discussion in the European Union are designed to make it possible to keep the final crop below the threshold (0.9%) at which labelling is required[22].

Northern Ireland, 'The Genetically Modified Organisms (Deliberate Release) Regulations (Northern Ireland) 2003, No. 167.

[17] Although Article 23 of the Deliberate Release Directive provides that a Member State may provisionally restrict the use and/or sale of a product on its territory where justifiable reasons to consider that the product constitutes a risk to human health or the environment have arisen since the grant of its Part C approval.

[18] In addition, a number of crops had received approval for import as commodities; this aspect falls outside the scope of the present report.

[19] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed; and Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning traceability and labelling of genetically modified organisms and traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. The food and feed regulation entered force on 7 November 2003 and applies from 18 April 2004. The labelling and traceability regulation also entered force on 7 November 2003 and will apply 90 days from publication of a system for development and assignment of unique identifiers for GMOs.

[20] Article 44(2) of Regulation (EC) No 1829/2003 (Food and Feed Regulation).

[21] This change to EC/2001/18 will not require changes to existing national legislation transposing the Directive because the amendment does not impose new duties but rather gives permission to introduce new arrangements on coexistence, at Member State level.

[22] The EU Standing Committee on Seeds discussed these proposals on 22 September 2003. France asked the European Commission to seek specific confirmation from the Scientific Committee on Plants (SCP) that the proposed thresholds would enable the 0.9% threshold for food and feed to be met. The SCP's earlier advice was clear that the proposed thresholds for seeds remained feasible even with the reduction in the food and feed threshold from 1% to 0.9% (see Table 1 on page 8 of the SCP opinion dated 13 March 2001). However, the Commission acknowledged that the SCP's opinion had been delivered before agreement had been reached on the 0.9% threshold and so it agreed the French proposal. The timetable is uncertain but a final vote in the

20. Legal provisions already exist prohibiting the use of GMOs in organic production (though not at present setting any special limit for the adventitious presence of GM material in organic produce and as such, in the absence of ratified standards, the proposals set for presence in non-GM foods would apply for the purposes of labelling).

Policy responsibility for GM matters in the UK

21. There are four Competent Authorities in the UK (one each for England, Scotland, Wales and Northern Ireland) for the purpose of consents for release and marketing of GMOs under the Deliberate Release Directive. For authorisations, all Competent Authorities will rely on the expert committees of ACRE[23] and ACNFP[24] for advice, but the questions asked of these bodies and the conclusions to be drawn from the advice will be for the Competent Authorities and relevant Ministers to assess. It follows that when Defra is acting on behalf of the UK as a whole (as the Member State of the EU), it must seek agreement from the other three Competent Authorities.

22. The policies of the devolved administrations in Scotland and Wales on GM crops are to varying degrees different from the stated policy of the UK Government, which is that it is neither for nor against GM crops.[25]

23. The Scottish Government has stated that: "We will rigorously apply the precautionary principle in our approach to the planting of GM crops. We will assess the results of the GM farm scale trials ensuring that there are opportunities for peer review and assessment by others including environmental organisations. Until this process is concluded, we will not permit further GM trials or commercial growing of GM crops"[26].

24. The Welsh Assembly Government has a policy of operating the most restrictive policy possible within the context of existing EU legislation on future GM crop development within Wales. During the Farm Scale Evaluations (FSEs), the National Assembly for Wales issued a prohibition notice under section 110 of the Environmental Protection Act 1990, to place a legal obligation on growers of T25 GM Maize to ensure that separation distances are observed between GM and non-GM crops. This prohibition notice was communicated to the European Commission via the UK Government through the Article 16 procedure under Directive 90/220/EEC[27]. Although the European Commission has questioned the legal basis for the UK action[28], it has not shared its legal advice with the UK. Until the Commission advises that the prohibition notice contravenes the Directive it remains in force. The administration in Wales has received no challenge from the seed producer Aventis (now Bayer), although we understand that the company has asked the administration on a number of occasions to justify the basis on which the action was taken.

25. Each devolved administration will now have freedom, if it so wishes, to introduce arrangements to ensure coexistence, as a devolved matter, including possibly

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Standing Committee on Seeds could take place from around the end of January 2004, with transposition by Member States of the Directive into national regulations taking place thereafter.

[23] Advisory Committee on Releases to the Environment .

[24] Advisory Committee on Novel Foods and Processes.

[25] The devolved institutions in Northern Ireland are currently suspended.

[26] Statement of 15 May 2003: http://www.scotland.gov.uk/library5/government/pfbs.pdf, p18.

[27] Now replaced by Article 23 of Directive 2001/18/EC.

[28] Letter Wallström to Beckett, April 2002.

regulation, following the introduction of legal authority through the coexistence amendment to 2001/18/EC. Moreover, the European Commission's draft guidelines on coexistence recommend that relevant regional differences are taken into account in developing coexistence measures. So different coexistence arrangements could in principle be put in place in Wales, Scotland, England and (possibly) Northern Ireland.[29]

The Farm Scale Evaluations in the UK

26. The UK has undertaken a programme of monitored plantings (the Farm Scale Evaluations: FSEs) covering winter and spring varieties of oilseed rape, beet (fodder and sugar) and forage maize[30]. In October 1998, the Government reached a voluntary agreement with SCIMAC[31] to delay large-scale commercial planting of GM crops for one year, while the FSEs were carried out. Following that initial year, the Government negotiated a new agreement with SCIMAC, announced in November 1999[32], which provided that the FSEs would be continued for the next three years, and there would be no "general unrestricted cultivation" of GM crops in the UK until they were complete[33].

27. The first set of results (for the spring-sown crops) was published in October 2003; those for winter-sown oilseed rape are expected to be published in 2004.

28. The Scientific Steering Committee overseeing the FSEs advised Ministers that:

> "Growing conventional beet and spring rape was better for many groups of wildlife than growing GM herbicide-tolerant (GMHT) beet and spring rape. Some insect groups, such as bees (in beet crops) and butterflies (in beet and spring rape), were recorded more frequently in and around the conventional crops because there were more weeds to provide food and cover. There were also more weed seeds in conventional beet and spring rape crops than in their GM counterparts. Such seeds are important in the diets of some animals, particularly some birds. However some groups of soil insects were found in greater numbers in GMHT beet and spring rape crops. In contrast, growing GMHT maize was better for many groups of wildlife than conventional maize. There were more weeds in and around the GMHT maize crops, more butterflies and bees around at certain times of the year, and more weed seeds."[34]

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[29] On the other hand, at time of writing, some Member States have called for EU-wide rules (rather than guidelines) on coexistence and stipulated this as a requirement for them to lift the informal moratorium on new approvals.

[30] The objective of the FSEs is to investigate whether the herbicide management associated with these GM crops, as compared with that used on the non-GM equivalents, has any effects on some aspects of farmland biodiversity – that is to say, on the number and diversity of plants and animals. For a detailed discussion of the FSEs, see our report *Crops on Trial*.

[31] The agreement with SCIMAC (the Supply Chain Initiative on Modified Agricultural Crops) was announced by Michael Meacher, Minister for the Environment, in his evidence to Sub-Committee D of the House of Lords Select Committee on the European Communities on 21 October 1998 (see HL Paper 11-II, 2nd Report Session 1998-99, Q 603).

[32] DETR News Release 507, "Voluntary Agreement on GM Crops Extended", 5 November 1999.

[33] The FSEs comprised a total annual average of around 400 hectares of GM crop cultivation. By way of comparison, about 700,000 hectares in total is grown annually of these conventional crops, of which around 1200 (0.2%) is organic.

[34] Scientific Steering Committee for the GM crop farm-scale evaluations: Final advice to Ministers 16th October 2003 (available on the Defra website: http://www.defra.gov.uk).

In addition:

> "The researchers stress that the differences they found do not arise because the crops have been genetically modified. They arise because these GM crops give farmers new options for weed control. That is they use different herbicides and apply them differently."[35]

29. The FSE results will now be considered by ACRE, who will advise Ministers on their implications. This advice is expected in December 2003 or January 2004. In the light of ACRE's advice, Ministers will decide the UK's position on whether these specific crops should be approved for commercial cultivation in the EU. The UK Government has also stated that in parallel it will also be reflecting on the findings of its GM dialogue - the public debate, the science review, and the costs and benefits study - and on this report, and that it will decide its overall policy on GM crops in the light of all the available evidence[36]. The Scottish and Welsh administrations are doing likewise.

The current position on commercial growing

30. The GM herbicide-tolerant maize transformation event (T25)[37] already has Part C approval. One variety of maize (Chardon) including T25 is at present being assessed for listing on the national seed list. The use of the associated herbicide with it under the pesticide regulations also remains to be approved. It is possible although unlikely that the regulatory process will be completed in time for farmers to plant the crop in spring 2004, subject to ACRE's advice on the FSE results for maize and no withdrawal of consent on the basis of the FSE results.

31. Large-scale commercial GM maize production in the UK in spring 2004 seems unlikely, however, regulatory considerations aside[38]. Market take-up will depend on a range of factors including the fact that even after a new crop becomes commercially available, it takes time to develop varieties suited to UK conditions; the tendency of any new crop technology to take-off fairly gradually (farmers like to see how suitable a new crop is for their farm, growing a limited amount themselves initially or noting the experiences of neighbours or demonstration farms); and because the UK consumer base is relatively weak.

32. The Deliberate Release Directive sets out deadlines for consideration of applications[39], and the Government seems likely to be obliged soon to give its

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[35] The implications of spring sown genetically modified herbicide tolerant crops for farmland biodiversity: a commentary on the Farm Scale Evaluations of Spring Sown crops. Firbank et al, October 2003. Conclusions - page 19. Available from Defra and on their website http://www.defra.gov.uk.

[36] Defra press release, 16 October 2003, *Farm Scale Evaluations – Important new evidence on GM crops.*

[37] The maize variety being used in the FSEs.

[38] Bayer CropScience was reported as stating on 29 September 2003 that "If the government says 'yes' to commercial GM crops, then GM maize would be he first to be planted, although it would be some time before we see GM rapeseed and sugar beet – maybe in 2006…It's possible that GM maize could be planted as early as next year, but this looks unlikely"; and that the quantities of GM maize planted would initially be relatively small. *Bayer says GM maize ready for planting in Britain*, Reuters Financial News, 29 September 2003 (http://www.reuters.com).

[39] Although the 'clock can stop' at different stages if and when a company is asked to provide further information in support of its application, so the total period of time taken to process an application is not fixed absolutely, and it remains possible in effect for Member States to continue (illegally) blocking individual approvals. It is not clear whether there will be any practical effect on operation of the approvals process as a result of the alteration in 2004 (effected by the new Food and Feed Regulations – see Annex A) to the approval mechanism, whereby the

opinion on some of the nineteen applications for Part C consent under the Directive which are currently awaiting decision. The early ones on which the UK will need to give an opinion or vote on applications, possibly by the end of 2003, are for import into the EU only rather than cultivation. Only six of these are for herbicide-tolerant GM crops which might be grown in the UK[40]. On these, the Government has commented that the UK will not be able to give its final view until it has assessed the final results of the FSEs[41].

33. Further information for Government decision-making has become available from the strands of the public "GM dialogue". The *GM Nation?* strand was discussed above. The two other strands of the GM dialogue, a review of science around GM, led by Professor Sir David King (the Government's Chief Scientific Adviser) working with Professor Howard Dalton (the Chief Scientific Adviser to the Secretary of State for the Environment, Food and Rural Affairs), with independent advice from the Food Standards Agency; and a study by the Prime Minister's Strategy Unit of the overall costs and benefits of GM crop commercialisation, considering a full range of possible scenarios for the future development of GM crops in the UK, including a "no GM" scenario, were both published in July 2003[42].

34. The Strategy Unit's central conclusions were that:

- existing GM crops could offer some cost and convenience advantages to UK farmers;
- however, any economic benefit to the UK is likely to be limited, at least in the short-term - only a narrow range of existing GM crops are currently suited to UK conditions, and weak consumer demand is likely to limit take-up;
- looking to the longer term, future developments in GM crops have the potential to offer more wide-ranging benefits, to farmers and to consumers - possibilities include GM crops with agronomic benefits more suited to the UK; GM crops delivering direct health benefits (e.g. delivering foods with reduced allergenicity or added nutrients); or non-food GM crops used as a source of pharmaceuticals and vaccines;
- however, the overall balance of future costs and benefits will depend on public attitudes, and on the ability of the regulatory system to manage uncertainties[43].

We draw on the analysis in the PMSU report throughout this report, and on the work of the Science Review Panel.

35. The Science Review Panel's first report[44] found no scientific case for ruling out all GM crops and their products, but nor did it give them blanket approval. It

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European Food Safety Authority (EFSA) will take the lead on approvals of all new applications for all food and feed deliberate release applications, rather than individual Member States.

[40] Of the other applications, the only ones involving cultivation (as opposed to import as commodities only) are for cotton (which is not suited to cultivation in the UK) and industrial starch potato (which is not intended for cultivation in the UK).

[41] Statement of 24 March 2003 on behalf of the Secretary of State for Environment, Food and Rural Affairs: see http://www.gmnation.org.uk.

[42] In addition, the Food Standards Agency (FSA) assessed consumer views through activities including surveys of young people and people on low incomes, a citizen's jury broadcast live on the internet, and a schools debate.

[43] *Field Work: Weighing up the Costs and Benefits of GM Crops*, Prime Minister's Strategy Unit, 11 July 2003. (Available at http://www.strategy.gov.uk)

emphasised that GM is not a single homogeneous technology and that GM applications need to be considered on a case-by-case basis. The Panel also emphasised the importance of GM regulation keeping pace with new developments. The Panel found that, for the current generation of GM crops, the most important issue was their potential effect on farmland and wildlife. We draw on the Science Review Panel's specific conclusions on gene flow and coexistence later in this report.

Supply of GM crops

36. It is important to have a clear understanding of how GM crops would reach the farmer for commercial production, if that went ahead. In the vast majority of cases, the agricultural biotechnology companies who have developed the GM events[45] will not develop and sell *seed* containing the GM event to farmers. A seed company will do that. The seed company selling the seed to farmers via seed merchants will not normally be the owner of the GM event and the part C consent holder. Rather, if a seed company were to sell a GM variety in the UK, it would be given a plant containing a GM event produced by an agricultural biotechnology company (such as Monsanto, Bayer or Syngenta). The seed company would make a cross to an agronomically useful variety suited to UK conditions, and then purify that variety in order to obtain a highly useful variety containing that GM trait. The biotechnology company, as the prospective or actual consent holder, would do all of the regulatory work including the environmental profiling of the GM.

37. Most UK seed companies are not owned by agricultural biotechnology companies. This is mainly because the UK market is seen by agricultural biotechnology companies as relatively unimportant in terms of global commodity crop production. Compared with major commodity crop production areas elsewhere in the world, only a relatively small amount of GM crops would ever be grown here[46]. So there will normally be a seed company as well as an agricultural biotechnology company involved in creating and supplying a particular kind of GM seed to UK farmers.

Our approach to looking for solutions

Listening carefully

38. We took a wide variety of evidence and listened to expert stakeholders[47], covering the spectrum of views on these difficult issues. We have been very conscious of the need to pay particular attention to the social and ethical dimensions around these issues, as well as the technical and legal ones, as we are charged to do in our terms of reference. We have sought to anchor our recommendations in the

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[44] GM Science Review Panel, First Report, 21 July 2003. (Available at http://www.gmsciencedebate.co.uk) The Science Panel has reconvened in autumn 2003 to consider its findings in the light of the results of *GM Nation?* and further scientific data, including the FSE results and comments on its first report.

[45] An 'event' in this context is a particular genetic modification leading to some effect in the plant, for example making a plant herbicide tolerant, or frost-resistant, or changing its colour.

[46] However, UK and EU decisions on GM crop and food approvals are important to agricultural biotechnology companies because of imports and the direct and indirect signals such decisions send to other parts of the world which do or potentially could be large GM crop production areas.

[47] See Annex E for more details.

wider social and political context in the United Kingdom and abroad. As noted earlier, we have had the facilitation of choice to consumers always uppermost in mind. Our report does not engage with all the general and specific points of debate around GM issues or even GM crops, but that should not be taken to imply that we were not acutely aware of all these, many of which have been current in the course of the public debate. We have developed this report against a broader canvas.

Limiting our scope

39. We defined the scope of our work in this report carefully, concentrating on key imminent aspects of decision-making:

- we limited our work to GM crops, excluding other GMOs. These will need separate consideration in future: we draw attention to our report *Animals and Biotechnology*[48], where we noted that the environmental impacts of GM animals, and particularly of fish and insects, might raise different issues from those raised by GM crops.
- within the range of potential GM crops, we have concentrated our detailed analysis on the first generation that might be commercially grown in the UK (that is, those which were included in the FSEs[49]), looking only briefly at other GM crops suitable for cultivation in the UK which may be nearing the approval stage. We would expect GM crops grown for pharmaceutical uses to require a different approach, and we have not considered GM trees. What we all recognise is that the approach taken to deal with coexistence and liability issues for this first generation of crops is likely to set the pattern, if not necessarily all the specific conditions, for any growing of future food and feed crops. So decisions at this stage to that extent represent a watershed.
- we have focussed on agricultural production as far as the farm gate (that is, the point when the crop leaves the farm for delivery to its immediate buyer, the merchant or the processor). Achievement of the desired standard at that point will carry through to the consumer only if the subsequent integrity of the chain is maintained. We have not made recommendations about those later stages[50], but we have taken them into account in making our recommendations.

Defining criteria for assessing solutions

40. In considering possible solutions to the issues we have considered, we have looked for options which would as far as possible:

- deliver choice for consumers
- allow farmers to deliver what consumers and markets want
- command support from a broad range of stakeholders, including the general public, farmers and the agricultural biotechnology and seed industries
- be achievable within the constraints of current or forthcoming EU legislation

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[48] AEBC, September 2002: see particularly paragraphs 57 and 115-117.

[49] Some of the existing first generation of GM crops is not suitable for UK farming conditions. For example, cotton, of which GM varieties are widely grown overseas, is not a UK crop; and Bt maize (designed to protect the plant against corn-borers (an insect pest) would not be in demand here because the corn-borer is not a significant pest in the UK due to our climate.

[50] The Food Standards Agency (FSA) is responsible for setting regulations on labelling of foods for GM presence, and local authorities are responsible for enforcement.

- be practicable in terms of farming practice and enforceability
- be consistent with delivery of environmental and future consumer benefits through farming
- be economically viable
- minimise disputes and claims, and facilitate dealing with any which did occur
- be proportionate to the issues being addressed
- be based on sound scientific and other evidence.

PART 2 COEXISTENCE

PART 2.1 CONSUMER AND PRODUCER CHOICE

Coexistence and choice

41. At the heart of the coexistence debate is consumer choice, predominantly expressed as domestic[51] consumers being able to continue to choose to eat non-GM or organic products, particularly products grown in the United Kingdom. Sometimes also raised in public debate is the corresponding case of access to home-grown GM produce for some consumers.

42. Demand for non-food and feed crops, however, need not be driven by domestic consumers. The customer may for example be an industrial fuel or lubricant producer, not a supermarket or food processor. Although initial GM crop introductions into the UK are likely to be for GM herbicide tolerance, future genetic modifications will produce crops designed for specific purposes such as nutritional qualities, specialist oils, disease resistance and energy crops. Some of us take the view that although the principal issues around coexistence relate to food and feed products, it is important that any action taken to seek to resolve those issues and deliver consumer choice should not as a consequence rule out production of non-food GM products, where there may be new markets for farmers, even in the short-term.

43. For farmers the predominant factor governing production will increasingly be market demand, from domestic or industrial consumers, as distortions to the market from production-based subsidies are reduced. Preserving choice for farmers is important in the sense that they need to be able to respond to changes in consumer and market demand. In the future, if there were to be widespread commercial growing of GM crops for food and feed, then this might indicate in itself that there was greater consumer and farmer acceptance and so less market pressure in general to meet low adventitious thresholds. Other scenarios are also possible. Reconnecting farmers with their markets is a key element of Government strategy for agriculture in the wake of the Curry report.

44. At present, domestic farming in the UK is able to deliver to consumers a choice of crops[52] grown by means of different conventional or organic agricultural production systems, but not GM crops. If the commercial production of GM crops made it impossible over time for UK farmers to produce crops meeting the respective thresholds, consumers would no longer be able to choose to buy domestically produced non-GM food (defined in law as below 0.9%); or organic food, at a 0.1% threshold (the self-imposed *de facto* threshold that has been adopted by the Soil Association, one of the main UK organic certification bodies, which has taken a public lead on the issue among organic certification bodies)[53]; nor might they be able to buy so easily non-organic food whose ingredients were at a commercially imposed

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[51] Individuals and households, rather than businesses.

[52] Although in practice CAP subsidies have had a warping effect on the operation of this market.

[53] We are not aware of any of the other UK organic certification bodies adopting a threshold different from that of the Soil Association.

level below 0.9%. On the other hand, prohibiting the domestic cultivation of GM crops would deprive consumers of the possibility of buying domestically produced GM food (and non-food products). In any of these cases, imported products would be available as substitutes (some 56% of organic food by value at present is imported), but that would not help UK farmers respond to UK consumer demand.

45. The European Commissioner for Agriculture has expressed the principle that "farmers should be able to cultivate freely the agricultural crops they choose, be it genetically modified crops, conventional or organic crops". He recognised that, unless special measures were taken, the commercial cultivation of GM crops might result in the "adventitious presence of GM crops in non-GM crops and vice-versa": in other words, GM plant material might turn up in a crop which was intended to be non-GM, or vice versa[54]. Coexistence gives rise to potential economic consequences for farmers, because as a result of adventitious presence a crop might fail to meet the relevant standards[55], and therefore command a lower price on the market. As noted in Part 1, there is now legal authority for Member States to implement national measures to promote coexistence.

46. Delivery of consumer choice also depends, among other things, on the operation of the supply chain beyond the farm gate. We have kept in mind the operation of the rest of the supply chain in our considerations about coexistence at the farm level.

47. In this section, we look at some of the background to the choices available to consumers (and farmers) in respect of non-GM, organic and GM foods and crops.

Factors in domestic consumer decision-making

48. Domestic consumer decision-making is a specialised field: we include only a very brief summary here of some key factors to help illuminate some of the background to underlying issues relating to consumer choice and GM food.

49. Consumer analysts commonly use a set of seven filters or questions to help assess the extent to which policy propositions are fit for the consumer purpose. One of these is choice. The others are information, access, safety, equity, redress and representation. But these seven filters are not mutually exclusive. When consumers make decisions some of the questions will be more important, depending on the decision and the consumer. And consumers will make trade-offs between the areas, even if they do not do this explicitly.

50. Only very rarely is this choice filter relevant on its own. The principle is that there should be as much choice as possible, but "possible" will be defined according to the nature of the decision. In public services, for example, consumers are often prepared to have restricted choice in the interest of universal access.

51. *Having a choice* involves:

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[54] Communication from Commissioner Fischler to the European Commission, Brussels, SEC(2003) 258. 25/02 2003. *Coexistence of Genetically Modified, Conventional and Organic Crops*

[55] These standards could include both thresholds of permissible GM presence in conventional or organic crops, and standards of purity in high-value specialist GM crops.

- being able to meet one's needs and fulfil one's desires (subject to one's available income[56]) – which raises issues about access, equity and redress
- being able to choose between products of various prices, qualities and characteristics – which raises issues about information
- having confidence that risk has been managed out, or that one is taking risks knowingly – which raises issues about safety, information, representation and redress
- being able to choose to limit one's own choice in deference to equity

52. To be meaningful, choice must be based on *information* which is relevant and usable. The information must be timely, appropriate to the decision, accurate and trustworthy. In terms of GM food and crops this might imply that information must at least be demonstrably correct on the basis of testing and/or traceability.

53. And consumers should have *access* to the goods and to information about them. Barriers to access (which are not specific to biotechnology) can include geography, disability, level of education and skills, income and availability. But the market, and producers and retailers within it, can also impact on access, as can regulators and public policy makers.

54. In relation to *safety*, consumers wish either to have risk managed out, or to know what risks they are taking so that they can weigh them against the potential benefits. Consumers will typically wish to be protected against risks which are unknown but potentially substantial, and which will either affect many people or affect a few people greatly. For products containing GM material, consumer safety concern where it exists is likely to relate to human safety at the point of consumption. For some consumers, concerns about environmental safety will also be a factor. Although the safety risks may be perceived as small, the risk/benefit equation may be far from straightforward for consumers if the first generation of GM crops offers only limited direct consumer benefit. Wider choice of new GM products with a perceived direct consumer benefit could affect the choice which the consumer makes.

55. Considerations of *equity* relate to the fact that one person's choice affects others:

- it may restrict the choice of other consumers. If GM products have proven utility, some people will choose to have them, but others will still want the choice not to have them: both groups may want to be assured that their personal choices will not be affecting others

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[56] Most surveys show that consumers are generally uneasy about GM food, but there is varying evidence as to how high avoiding it comes in their list of priorities. Consumers in surveys generally put price at the top of their list (see Food Standards Agency consumer surveys, http://www.food.gov.uk), followed by animal welfare and environmental issues, with GM a considerable way down the list. But looking at this from another angle, it can be argued that the reason price is top of the list of concerns is simply because most people are shopping on a budget. Research with iow-income consumers undertaken by the National Consumer Council (*Feeding into Food Policy: Submission to the Farming and Food Policy Commission on the views of low-income consumers*, National Consumer Council, November 2001, http://www.ncc.org.uk) as part of its evidence to the Curry Commission indicated that the participants cared deeply about the food they ate and how it was produced. Despite being on low incomes their concerns ranged far beyond merely ensuring affordable food was available to them.

- it may affect the interests of others who need protection (for example by having an impact on consumers and employees in developing countries)
- it may affect the environment, hence having an impact on inter-generational equity

56. Generally speaking in consumer decision-making, provision of adequate *redress* at both individual and collective levels requires that if things go wrong there will be easy access to a simple, well-publicised, rapid, equitable system, providing adequate compensation and an assurance that things will be better for others.

57. Consumers need *representation*. They should be involved, so that their needs are identified, their concerns are met, and their interests are given equal weight with those of producers. Consumers will want to be reassured that issues around coexistence are being considered holistically.

58. So consumer decision-making in relation to GM foods is not a simple matter of exercising a choice between two products at the food counter. Also essential are to:

- understand what consumers want and need
- provide meaningful information
- assure sound risk assessment and adequate precaution
- establish utility
- provide clarity about the equity implications of options
- establish a system of redress
- be transparent about these with consumers.

Demand for specific products

Consumer demand for 'non-GM' products as interpreted by retailers

59. The producers and retailers of food products translate consumer demand into demand for farmers' output. UK supermarkets perceive their customers as demanding non-GM food. Their own-brand products are therefore non-GM (which at present means that they must contain less than 1% of GM material).

60. But the supermarkets state that they are going further than this. We have been told variously that they are working "at", "to" or "towards" remaining within a 0.1% threshold, not merely for products described as organic, but for a wide range of their own-brand products (we are not sure if the supermarkets distinguish between premium and non-premium own brands in this respect, but have heard no evidence that they do). The supermarkets state that they seek to achieve this partly through testing, but partly through identity preservation (IP) systems. On 13 February 2002, John Longworth, Director of Trading Law and Business Affairs, Tesco Ltd (and Chairman of the Directors Technical Forum of the Institute of Grocery Distribution, and a member of the Food Policy Advisory Group for the British Retail Consortium) said in evidence to a House of Lords Committee[57]: "Tesco brand as a range has no

[57] House of Lords Select Committee on the European Union, *Labelling and tracing of GM food and animal feed: informing the consumer*, HL Paper 92, 15th Report Session 1998-99, QQ 69 and 71. This Report also contains other interesting evidence.

GM or GM derivatives in it ... We decided to remove the GM from the Tesco brand in order to provide a choice between Tesco brand and the branded products which we sell in our stores as well ... Customers showed their preference to the extent that the branded manufacturers then decided to remove GM from their products too ... I am not aware that another supermarket is intentionally selling GM"[58]. The UK's principal supermarkets recently confirmed that this remains their policy, based on their assessment of consumer wishes[59]. A recent survey by BBC News On-line confirmed this[60]. The Co-operative Group has announced that as well as banning the sale under its own brand label of any products that contain GM ingredients, it will not allow the growing of GM crops on its land[61]. However, supermarkets continue to sell products manufactured using GM processing aids, notably vegetarian cheese, which is not required to be labelled as having been produced using GMOs.

61. GM animal feed (particularly soya) is already used in conventional livestock production in the UK. Some sectors, such as the poultry industry, use non-GM feed only, and all organic livestock production avoids using GM feed, but non-GM sourcing has not been adopted across the industry, partly as a matter of interpreting consumer demand for products derived from livestock fed specifically on GM material, and partly because of question marks over whether this would be practicable, particularly given the heavy use of imported soya products for livestock production.

62. The British Retail Consortium (BRC) describes itself as the lead trade association representing the whole range of retailers, from the large multiples and department stores through to independents, selling a wide selection of products through centre of town, out of town, rural and virtual stores. According to its website[62], "retailers will consider the sale of GM food to foods containing GM ingredients, provided they have clear approval from the regulatory authorities and where they have confirmed a clear customer demand. Such demand could arise from the offering of food that demonstrates a real benefit to the consumer, for example, food which has an enhanced nutritional content, an improved taste or keeping quality or a lower price ... Retailers are committed to giving their customers informed choice". As noted above, this policy has not changed, nor have the BRC or leading retailers given any indication that it is likely to do so in the present circumstances.

63. A recent survey in 2003 by IGD, which provides data services on consumer attitudes for the food and grocery industry, found that in terms of consumers' attitudes in practice, "GM currently appears to [be] making little difference to

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[58] He did not at that time suggest that Tesco or other supermarkets were aiming for a level of GM content below the 1% prescribed in EU legislation.

[59] From *The Guardian*, 'Shops' unlikely to stock GM', 16 July 2003: "Richard Ali, director of food policy at the British Retail Consortium, said: "Our position remains unchanged. We are neutral on GM technology. But we provide what customers demand and they do not want GM food." Mr Ali said a shift would probably come only if it was proved that GM products had tangible benefits for consumers - for example, extra vitamin content. The communications director for Safeway, Kevin Hawkins, said: "I think it's very difficult to see what will move public opinion. We have certainly seen no change in what people think about GM." Kate O'Sullivan of Sainsbury's said: "Customers have made it clear they do not want GM ingredients." Tesco and Asda also said they had seen no radical change in public attitude."

[60] *Where supermarkets stand on GM food*, BBC News On-line, 21 October 2003. (http://news.bbc.co.uk/1/hi/uk/3211510.stm)

[61] Co-operative Group announcement, 20 October 2003. The Co-op is the UK's single largest farmer.

[62] http://www.brc.org.uk.

consumers' shopping patterns. Instead, most are showing a passive acceptance of GM food"[63]. This conclusion was based on the following breakdown of responses:

- 47% I am not really interested in looking at the list of ingredients in the food I buy
- 27% I would prefer not to buy any GM food but I rarely look at the label to make sure this is the case
- 13% I always look at the label to make sure the food I buy does not contain any GM ingredients
- 13% I am quite happy for the food I buy to include GM ingredients.

These results would appear to be at variance with an opinion poll of Co-op customers carried out prior to the Co-op's October 2003 policy announcement, in which 79% of the 1183 people surveyed said they would not knowingly buy food containing GM ingredients[64]. Either way, there appear to no signs at present as far as we can judge of a significant shift on the part of UK retailers from a stated policy of avoiding GM in their own produce.

Demand for organic products

64. At present, organic food retail sales (with a value of over £1 billion) account for around 2% of total retail food sales in the UK[65]. Of the organic food sold, some 44% by value is domestically produced[66]. The UK organic farming sector has been growing, and is likely to continue to do so, driven both by demand and by Government policy, even if not for every product (for example, there has recently been an oversupply of organic milk in the UK).[67] A recent survey predicts 10% average annual growth between now and 2007, taking the annual value of organic sales to a projected £1.6 billion[68].

65. There is room for argument (based on the results of different surveys) about the extent of demand for organic products in relation to the price premium, as well as about what the general public understands "organic" to mean[69] in respect of adventitious presence of GM material. But the basic facts of level of demand are clear enough. To some of us, the Government support of organic agriculture is at variance with its declared policy in response to the Curry Commission that trade-distorting support should be removed.

Demand for "GM" products

66. Retailer sourcing decisions are based on an assessment that there is not at present significant positive consumer demand for food containing GM material from the first generation of GM crops. Proponents of GM crops generally accept that

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[63] IGD, Consumer Watch 2003. *August's Edition: GM Food and Farming: What are Consumers' Latest Views?*, (http://www.igd.com/consumer)

[64] Poll carried out by NOP World

[65] *Organic Food and Farming Report 2003*, Soil Association, (November 2003)

[66] *Action Plan to develop Organic Food and Farming in England*. Published by Defra, July 2002

[67] Defra prepared a note on likely demand in conjunction with the Organic Action Plan which can be viewed on the Defra website at www.defra.gov.uk/farm/organic/actionplan/prospects.htm.

[68] *Organic growth hampered by price barriers*, Datamonitor, 31 October 2003.

[69] In a recent article on organic food, *Which* said "Organic food shouldn't contain any GM ingredients, but it's not proven that pollen can't drift from where GM crops are being grown, so it's difficult to rule out fully the chance of contamination. But shopping organically does support farming methods that many consider more beneficial to the environment and to the welfare of farmed animals" (May 2003, p22).

particular kinds of maize, soya or oilseed rape[70] products, GM or not, are not products likely to grab consumers' attention. They are ingredients in food or refined oils, or used as animal feed, rather than a clearly distinct product which might be perceived to offer clear consumer benefits. Future GM crops with distinctive direct consumer benefits might be more popular. Or some consumers might buy some GM varieties in the future on the grounds that they had been produced in more environmentally friendly ways than conventional equivalents – *if* there was generally accepted evidence of this for the crops in question. What is clear is that, as the PMSU report on the costs and benefits of GM crops concludes, the extent of GM crop cultivation in the UK will in large part be determined by public attitudes. Obviously Government policy would need to permit their cultivation if farmers were to be able to respond to future consumer demand for GM products.

67. Public views do seem to distinguish to some extent between commercial food and non-food and non-feed applications of GM technology, as well as possibly between different kinds of GM food products. Some of us think that, particularly given the potential environmental benefits from greater use of renewable energy sources, non-food GM energy crops could attract greater levels of public acceptance than GM food or animal feed crops enjoy at present.

68. Organic food is sold on the basis that no agrochemicals are used in its production; however 98% of the food in the UK is produced with the aid of agrochemicals at lower cost. While the consumer may express a wish for food to be produced in the absence of artificial fertiliser or herbicide, when provided with the choice of higher priced organic or lower priced conventional food the majority of consumers clearly opt for the conventional product. Some of us would extend the same argument to GM food products, which could be produced at lower cost and high quality. Indeed when a GM tomato product was sold in the UK at a competitive price to its conventional competitor the GM product achieved significantly higher sales[71]. Thus to restrict the production and sale of GM products, other than for reasons of human health or environmental safety, would be to restrict the exercise of choice by the consumer.

Information for consumers

Labelling

69. For consumers to make an informed choice in relation to genetic modification, products need to be appropriately labelled[72]. Legislation already provides for labelling where a product has a content of GM elements above a certain percentage level (at present 1%, but to be reduced soon to 0.9%). The new European Directives on food and feed and traceability and labelling provide for similar labelling if an ingredient of

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[70] Most soya products, GM and non-GM, are used in animal feed rather than food.

[71] GM tomato puree was on sale in Sainsbury's and Safeway from 1996, clearly labelled as such. It was made from GM tomatoes that contained more solids and less water than conventional varieties. It was sold between 10-15% cheaper than the conventional puree. The GM variety substantially outsold the conventional equivalent but following the public controversy about GM foods from 1998 onwards, the tomato puree and other GM products were largely withdrawn by major retailers and food manufacturers.

[72] For more detail, see Annex A.

a product has a content of a GM-*derived* element above the same percentage level, even if no GM elements are detectable in the final product[73].

70. For products marketed as organic, European law does not at present contain any more stringent threshold for GM *content* than the one that applies to all "non-GM" products, though it does ban the *use* of GMOs in organic production. There is provision for the introduction of a "*de minimis* threshold for unavoidable contamination which shall not be exceeded"[74]. But no such threshold has yet been agreed. At the 29 September European Council discussion, a number of Member States' delegations wondered about the need for a specific tolerance threshold for the adventitious presence of GMOs in organic agriculture and wanted this discussed further[75]. There is some ambivalence among EU Ministers: they feel that organic products should be GM-free in principle, but are worried about the costs for the organic sector of setting a lower threshold. We understand that there is likely to be a European Commission proposal recommendation on what to do about setting an organic threshold as part of their organic action plan due to be published in March 2004.

71. EU legislation on organic products is enforced in the UK by Government. Government may establish its own standards where EU legislation is silent. Rather than police organic standards itself, Government's focus is to ensuring that certifying bodies correctly interpret and implement them[76]. Organic certifying bodies require operators to take all reasonable measures to prevent the use of GMOs, and they maintain the right to remove the organic status of a crop where traces of GM are found in it, or where a significant risk of "contamination" is established and the farmer is unable to take steps to avoid it. They may also remove the certification of a field or an entire farm in certain circumstances[77].

72. As noted earlier, the Soil Association[78] maintains a self-imposed stance of 'zero tolerance' to adventitious presence of GM material in any product described as organic[79]. This is a departure from its normal approach, which depends on production method rather than analysis of output and so does not have zero tolerance of other unwanted material, like insect parts and pesticide residues, present to a greater or lesser extent in any crop, whether organic or not. This policy is seen by some of us to be directed towards establishing a barrier to any production

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[73] Products which are not so labelled and not organic are referred to in this report as "non-GM".

[74] In a new Article 13 inserted into the original 1991 Regulation by the 1999 Regulation, allowing for the adoption of implementation measures under a special procedure prescribed by Article 14.

[75] See http://ue.eu.int/pressData/en/agricult/77451.pdf.

[76] Defra and the devolved administrations produced in March 2003 a draft new compendium of organic standards, (http://www.defra.gov.uk/corporate/consult/organic-compend/index.htm.) which was the subject of consultation and is now being developed in the light of comments received.

[77] Ministers have established an Advisory Committee on Organic Standards (ACOS) as a successor to the United Kingdom Register of Organic Standards. ACOS will advise Government on organic standards, approval of organic certifying bodies and research and development.

[78] Among organic certification bodies, the Soil Association's certifying arm, SA Cert Ltd, certifies more farmers and growers than any other individual body in the UK (2308 out of 4057 at December 2002). The Scottish Organic Producers Association (SOPA) covers the largest area of farmland (378697 out of a total area of 724523 hectares that are organic or in conversion), by virtue of the extensive livestock farming common in Scotland. Organic Farmers and Growers is the second largest in terms of number of members, with 945 members. SOPA has the third biggest membership (558 farmers and growers). The remaining bodies all operate on a much smaller scale than these three.

[79] SA Cert Ltd. handles inspection and certification on behalf of the Soil Association in accordance with that principle.

of GM crops in the UK. The Soil Association says that its adventitious presence standard reflects its interpretation of what the market expects from organic foods (including the integrity of the system as a whole, the values it encompasses in terms of promoting human and environmental safety and therefore confidence in the organic sector, and its market future)[80]. The Soil Association at present works on the basis that a 0.1% threshold is the lowest practicable, reliably detectable limit and that this threshold can therefore stand as a proxy for 'zero' adventitious presence[81]. Any breach of this and the Soil Association would not permit the product to be labelled as organic. Other UK organic certifying bodies have been less prominent in the debate, but we have had no indication from others of plans at present to adopt a more relaxed threshold.

73. Informal soundings suggest that organic certifying bodies in other European States vary to some extent in the approach they are taking to setting a specific threshold for organic produce in addition to the statutory threshold of 0.9%. In at least some countries besides the UK, including Italy, Denmark and Austria, they seem generally to have a policy of working to a lower threshold than 0.9%; others have taken no formal position on a threshold, although all organic producers would almost certainly wish to keep their product below the 0.9% level so as to avoid having to label organic produce as containing GM material. Internationally there is a wide variation on the status of labelling of products on the grounds of adventitious presence, and in the threshold for labelling, as the table below shows. Most of the countries in Table A have not as far as we are aware adopted formal coexistence measures[82].

TABLE A. Non-GM labelling thresholds.

Country	Status of labelling	Adventitious presence threshold	Notes
Argentina	None required	No specific figure	No formal coexistence arrangements
Canada	Voluntary	No specific figure	No formal coexistence arrangements
USA	Voluntary	No specific figure	No formal coexistence arrangements
New Zealand	Mandatory	1 %	Coexistence measures would be developed on a crop by crop basis and specified in crop release consents[83].

[80] Evidence given at stakeholder seminars and informal meetings.

[81] "Our position is that the issue of co-existence must include the continued possibility of GM-free production (with a maximum 0.1% contamination 'threshold'); that the costs of preventing contamination or for any negative consequences must be borne by those seeking to gain from GM crops in particular the biotechnology companies; and that if it comes to a choice between organic and GM production then organic farming should be prioritised because of its proven environmental benefits, consumer support and Government commitments." *GM crops policy update March 2003*, Soil Association, March 2003.

[82] Source: http//www.isaaa.org/kc/issues/labelling.

[83] At present no GM crops are grown in New Zealand. GM commodity crops such as soya and maize are unlikely to figure large in New Zealand: other crops would be more suited to the local agricultural mix. The Royal Commission for New Zealand recommended that a crop-by-crop industry code of practice to ensure effective

Australia	Mandatory	1 %	Cotton is the only GM plant cultivated commercially in Australia to date.
China	Mandatory	0 %	-
Brazil	Mandatory	4 %	GMOs banned but with recent one season waive on ban; however illegal import of seed has already led to growing GM crops in parts of the country.
Russia	Mandatory (selected products)	Data not available	-
Switzerland	Mandatory (for feed)	3 %	-
Japan	Mandatory (selected products)	5 %	24 products so far identified from maize and soya beans
Saudi Arabia	Mandatory	1 %	-
Czech Republic	Mandatory	Data not available	No product has yet appeared with new label
Thailand	Draft	Data not available	-
Taiwan	Draft	5 %	-
Israel	Draft	1%	Proposals in general follow EU model
Malaysia	Draft	3 %	-
Hong Kong	Draft	5 %	-
India	Draft	Data not available	-
South Korea	Mandatory	3 %	Only if GMO is one of top 5 ingredients

separation distances between GM and other crops (including seed crops) be set up, but that there was some merit in waiting to see which crops might be grown first in New Zealand before making general provisions. The code should take into account distances required for seed certification and also developments in international certification standards for organic production and also any emerging strategies for coexistence in other countries. In the meantime, the New Zealand regulator, the Environmental Risk Management Agency (ERMA) expects to specify coexistence measures in consents for applicants or registered users (including abiding by separation distances set by ERMA, registering locations of GM crops, storage requirements, etc). The New Zealand Government has decided at this stage not to set up the new nationwide mediation service recommended by the Royal Commission, preferring to rely on existing mechanisms and keep the situation under review. The Government has also encouraged the adoption of a strategy to mitigate the impacts on honey arising from any release of GM flowering, and strategies to help preserve the long term effectiveness of Bt insecticide. Although GM organisms and products derived from them are expressly prohibited from deliberate use in organic production world-wide, the New Zealand organic rules are currently silent on the unintended presence of GM material in organic products. (Source: Government response to Royal Commission on Genetic Modification: Report on Managing the effects of GM organisms and coexistence in primary production. 17th April 2003. Available from Ministry of Agriculture and Forestry, Wellington, New Zealand, http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/biotechnology/index.htm.)

74. What it is actually possible to tell consumers about the GM content of products, or of ingredients, will depend on the accuracy with which it is possible to test products or to trace the origin of products or their ingredients.

Testing for GM content[84]

75. We have considered the various methods available to test for the presence of GM constructs. The two protein-based tests have limitations; a more reliable test that amplifies DNA for testing takes longer and is more expensive. The effectiveness of testing depends in part on the proficiency of individual laboratories, and at present there is limited laboratory capacity.

76. The lower the level of GM presence that is desired, the larger the sample has to be. It is generally agreed that 0.1% is the lowest level that can reliably be detected in practice and that even if techniques of analysis improve, that level is unlikely to fall. This is because testing for lower thresholds, although possible, would require very large samples and would be much more costly and so is not a practicable option for commercial crop production. Accurate testing requires a crop to be thoroughly mixed making it very challenging to test to the level of 0.1% on the farm, although easier at the processing stage, by which time there would probably have been much more thorough mixing. It is not certain to what extent farmers and producers would in practice be willing or able to meet this requirement. Having thresholds for GM material is not unique: no harvested crop can avoid containing some foreign material. Processors operate thresholds for impurities such as insect parts, other crops, weed seeds etc. The value of a crop is affected if these are excessive, but some tolerance is built into normal production and trading. There are also tolerances for non-organic material in some aspects of organic production, such as allowing at present 10% (for herbivores) or 20% (for other species) of animal feed for organic livestock production to come from non-organic sources where sufficient quantities of organic feed are unavailable. Some of us think that there is no logical case, legal considerations aside, for testing for GM material to any greater or lesser extent than testing for other impurities.

77. Work is being coordinated by the European Commission's Joint Research Centre, involving laboratories in different Member States (the Central Science Laboratory here), to standardise testing to the best available molecular techniques (closed system PCR), with standard sample sizes and sensitivity. This will allow the consumer to be confident that he or she is not being presented with misleading comparisons of genetic purity in different products depending on the country of origin, at least within the EU. The World Health Organisation (WHO) and the European Committee for standardisation are currently working towards harmonising protocols for GM testing methodology across the International Community.

Traceability

78. The labelling legislation[85] will extend the current labelling provisions to all food and feed produced from GMOs, even if no DNA or protein of GM origin is detectable

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[84] See Annex B for detailed information on testing and its limitations.

[85] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed; and Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning traceability and labelling of genetically modified organisms and

in the final product. Because testing the actual product being sold would not tell the consumer how it had been produced, a traceability system would require each operator in the production and distribution chain to transmit to the next operator information that a product consisted of, contained or (in the case of food or feed) was produced from GMOs[86].

79. When the traceability requirements enter UK law, it is not yet clear what monitoring and enforcement arrangements would apply[87]. The traceability requirements encompass the whole food chain, which obviously includes products as they leave the farm.

Recommendation 1: The main aim of Government policy on coexistence of GM and other crops must be to facilitate consumer choice to the greatest possible extent, while allowing UK farmers to respond to present and future national and international market demand.

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traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. The food and feed regulation entered force on 7 November 2003 and applies from 18 April 2004. The labelling and traceability regulation also entered force on 7 November 2003 and will apply 90 days from publication of a system for development and assignment of unique identifiers for GMOs.

[86] Because there is frequently no detectable difference between refined products from GM and from other crops, labelling will depend entirely on traceability, often across international boundaries.

[87] At present, the Food Standards Agency (FSA) is responsible for setting regulations on labelling of foods for GM presence. Local authorities are responsible for enforcement. The GM Inspectorate (based at the Central Science Laboratory for England and Wales, and the Scottish Agricultural Science Agency for Scotland) is responsible for monitoring and enforcement of conditions on consents to cultivate GM crops.

PART 2.2 CRITICAL CONTROL POINTS FOR COEXISTENCE

80. We have considered whether it might be possible to introduce coexistence arrangements to maintain genuine choice in the event of a decision to allow the production of one or more GM crops on a commercial scale.

The critical control points

81. We looked at the critical points where adventitious presence might be introduced into a non-GM crop on the farm, in order to consider what action might be taken to avoid this happening[88]. We identified the following possibilities:

- some GM material may have been present in seed purchased as non-GM or farm-saved
- there may have been gene flow by cross-pollination between the non-GM crop and a neighbouring sexually compatible GM crop of the same species
- seeds arising from a previously planted GM crop may have survived, as volunteers, until a non-GM crop of the same species is grown in that field
- plants from a GM crop may have pollinated certain sexually compatible wild relatives, which may then have survived in field margins to cross-pollinate with a succeeding non-GM crop of the same species
- the integrity of the non-GM crop may not have been maintained up to the farm gate[89]

We look separately below at each of these possible causes of adventitious presence, and at the steps that can be taken to minimise it. More details of the lifecycles and particular issues arising in relation to each of the FSE crops are given in Annex C.

Seed purity

82. Seed is either purchased from a merchant or farm-saved.

83. Seed sold by a merchant as non-GM may contain some GM material. At present there are no legally established thresholds for seed, only an EU guideline of 0.5% for authorised GM events and 0% for unauthorised events. Seed production relies on identity preservation systems with testing only undertaken for 'at risk' crops (such as oilseed rape or maize). Proposed EU legislation[90] would set maximum thresholds for seed production, designed to enable crops grown from "non-GM" seed to meet the threshold specified for a non-GM final product (1% now, soon to be 0.9%). Levels of GM presence in seed would need to be monitored by identity preservation systems[91].

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[88] We have limited our consideration to critical points up to the farm gate (that is, up to the point where the product leaves the farm for delivery to its immediate buyer, the merchant or the processor). Product integrity must then be maintained throughout the food chain, through storage and processing, but that is beyond the scope of this report.

[89] These factors were considered by the Scientific Committee on Plants (CONT/002-FINAL 13 March 2001) Opinion of the Scientific Committee on Plants concerning the adventitious presence of GM seeds in conventional seeds.

[90] Commission proposals on thresholds for the adventitious presence of approved GMOs in seeds, (SANCO/1542/02July2002). See Annex A.

[91] With the processes and provenance open to inspection by the GM Inspectorate.

The higher the GM content in the seed, the less "headroom" there would be for keeping below the threshold of 0.9% for the presence of GM constructs in the tested crop material[92], and the more likely it would be that a 0.1% threshold would be breached.

84. On the 0.1% threshold, given that the planned threshold for seeds is between 0.3% and 0.7% depending on the crop, special arrangements might be needed for organic seed production for some crops, and for the production of non-organic seed if non-GM farmers were working to a similar threshold, were GM cropping of the relevant crops to become widespread. This is because a batch of seed not labelled as GM because it is below the labelling threshold could in fact cause a breach of the 0.1% threshold in the final harvested organic or non-GM crop because the level of GM in the seed was greater than 0.1%.

85. Organic farmers are already finding some difficulty in obtaining sufficient organic seed for some crops and a derogation is in place at present. Although we understand that the present supply problems are unrelated to GM crop cultivation, widespread GM cultivation could in time add to these supply difficulties. This would be a greater problem for organic agriculture were GM varieties of more popular organic crops than niche products such as organic oilseed rape to become available and be widely grown, and a 0.1% organic threshold maintained (unless cultivation of presently niche organic crops increased markedly). On present cropping patterns, however, only a very little seed (0.5 tonnes) would be needed to supply the entire organic market. This would not be difficult to produce.

86. Maintaining consumer choice for organic and non-GM produce as presently defined will depend on the continued viability of organic and non-GM seed production respectively. There would be potentially a much bigger problem presented by adventitious presence in seed if many non-GM farmers were working to a similar 0.1% threshold as organic producers, as much greater volumes of production would be affected[93].

Farm-saved seed

87. Farmers may legally save seed of certain crops licensed by the British Society of Plant Breeders (BSPB), subject to payment of a fee[94], and for hybrid varieties subject also to the permission of the individual breeder of the variety concerned. Farmers are legally obliged to provide details of their use of farm-saved seed[95]. Oilseed rape is the only one of the FSE crops for which it is practicable for seed to be farm-saved provided permission of the individual breeder is given[96]. It is possible that levels of

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[92] We note that a certain percentage level of GM presence in seed (n%) does not necessarily of itself cause an adventitious presence level as high as n% in the crop material, because of inheritability and expression considerations. Seed containing up to n% of GM material would in most cases be expected to produce a crop with between 0.75n% and n% GM material.

[93] In their October 2003 position statement on GMOs the statutory conservation agencies press for legislation to set and enforce standards of seed purity that ensure adequate protection of the environment. They state that this is not just a consumer choice issue, noting that out-crossing from some GM crop plants could lead to gene-stacking and consequently more damaging herbicides or weed control practices being used to control volunteers or weeds.

[94] From which "small farmers", as defined for the purposes of IACS, are exempt.

[95] The royalty collection scheme for farm-saved seed could perhaps be used to monitor adventitious presence levels in farm-saved seed too.

[96] Maize seed cannot be produced in the UK because of climatic conditions: it is all imported from the EU or the USA. There is no farm-saved beet seed in the UK, nor is there ever likely to be, for a combination of technical, agronomic and (monopoly) purchaser reasons. For oilseed rape, conventional farmers make significant use of

GM material in what was supposed to be non-GM farm-saved seed could accumulate over the years if GM cultivation becomes relatively common. If GM cropping were on a small scale, the level of GM could not accumulate over time due to heterozygosity.

88. If GM production were pervasive, it is argued that it may become difficult to save non-GM seed from crops on farms where GM oilseed rape had been grown, because gene flow would occur from GM seeds in the field seed bank as well as from GM pollen dispersal[97]. Organic farm-saved seed would need to be produced from crops with very effective isolation (for example, by using only seed harvested from the centre of field crops).

89. It could be, therefore, that it would no longer be sensible for some or all farmers to save non-GM oilseed rape seed if GM cropping of oilseed rape became widespread, depending on how low were the thresholds to which farmers were working (the UK organic oilseed rape market would require only around 0.5 tonnes of seed in total each year, which could be supplied easily). At the very least, farmers saving their own seed might wish or could be required to take the precaution of having it tested before use, rather than risking producing a crop that would fail to meet the threshold, or inadvertently affect a neighbouring crop. Such testing could be expected to be made a condition of claiming on any compensation scheme for economic loss arising from adventitious presence. It may be that the non-GM farmer would have sometimes to buy seed rather than save it, if GM cropping were widespread. This could impose a new cost, therefore, on the non-GM farmer if GM crops were commercialised, which would be expected to be reflected in a price premium for the crop. It could also restrict the ability of farmers to choose farm-saved seed as an agricultural option.

Gene flow through cross-pollination

90. A non-GM crop could cross-pollinate with a sexually compatible neighbouring GM crop. The potential for gene transfer from cross-pollination is very different depending on the crop and the variety[98]. For example, wheat mostly self-pollinates; maize is the opposite.

91. Suitable separation distances between GM and compatible non-GM crops can very significantly reduce the amount of adventitious presence caused in the non-GM crop *by cross-pollination*[99]. The separation distance is measured between the boundary of a GM crop and that of a non-GM crop of the same species[100]. In addition to separation distances, pollen barriers[101] may minimise or prevent pollen spread.

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farm-saved seed: estimates of the percentage of oilseed rape seed in the UK which is farm-saved vary from 15-20% (NIAB) to some 40% (coexistence stakeholder seminar).

[97] *Round Table on Coexistence: Rapporteur's Report on Session2: Oilseed rape.* Jeremy Sweet, NIAB, UK. (http://europa.eu.int/comm/research/biosociety/pdf/rt_oilseed_rape_rapporteurs_%20report.pdf)

[98] Moreover, it is important to note that it is only the distance *viable* pollen travels that is important for coexistence.

[99] *Report on the separation distances required to ensure cross-pollination is below specified limits in non-seed crops of sugar beet, maize and oilseed rape.* Jan Ingram, 2000.

[100] Which could be on a neighbour's land or on the farmer's own land.

[101] Barriers of a different non-compatible plant species, normally tall species such as hemp, miscanthus or rye, planted around the GM crop; or, say, planting beside a wooded area; or a buffer zone i.e. a non-GM strip of the same variety as the GM crop which will be treated as GM post-harvest.

92. Peculiar local conditions of wind-caused pollination or insect activity could increase the distance over which cross-pollination might occur. There have been observations which suggest that, even on a whole-field analysis, in some fields at some times separation distances designed to meet a threshold of 0.1% from cross-pollination would fail to do so[102].

93. In relation to gene flow from cross-pollination it has been suggested that there could be a "scale effect" of "pollen flooding" as the level of production of GM crops increased. Some have reservations as to whether a regime designed on the basis of data on gene flow obtained from relatively small scale studies would be adequate to cope with a potentially much greater area of commercial crop production. The studies have estimated the distance which viable pollen may travel, but in the "tail of the distribution" (i.e. at large distances from the GM crop) it becomes much harder to estimate accurately the amount of pollen left. If GM crops are grown on a commercial scale, the background level of pollen will rise, possibly resulting in GM pollen occurring at greater distances than was previously supposed. In particular, "it is still difficult to predict what will happen when GM oilseed rape is grown as a high proportion of the rape crops in a region"[103]. It can be argued however that, were GM food crops being grown on a wide-scale, this would be because there was greater consumer and market acceptance of GM crops and so achieving very low thresholds would have become less of an issue. This argument would not necessarily hold if the widespread production of GM crops was for non-food uses.

94. However, one of the main messages from our technical workshop[104] and the GM science review[105] was that gene flow from pollen transfer would not generally be the main determinant of successful coexistence. The need for separation distances has sometimes been taken as a proxy for the overall need to minimise adventitious presence. We must therefore emphasise that among measures to promote coexistence, crucial as separation distances may be, they would not be the only relevant measure, nor necessarily the most important one, were commercial growing to occur.

95. In Part 2.3 we examine further for specific crops the separation distances that might be expected to be employed to try to keep below the key adventitious presence thresholds.

Volunteer populations

96. Volunteers are - to put it simply - crop plants growing somewhere they are not wanted. This could be GM plants growing in a non-GM crop, or GM or non-GM plants growing elsewhere on the farm.

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[102] Evidence from Professor Perry given at AEBC meeting Edinburgh 11/12 September 2002. http://www.aebc.gov.uk/meetings. Also, Defra monitoring contracts (EPG1/5/84 and EPG1/5/30) on gene flow from GM oilseed rape showed that on occasion cross-pollination levels could exceed 0.5% even at distances of 100-200m (http://www.defra.gov.uk/environment/gm/research/epg-1-5-84.htm); and 'Pollen-mediated movement of herbicide resistance between commercial canola fields' *Science* **296**: 2386-2388, MA Rieger, M Lamond, C Preston, SB Powles and RT Roush, 2002.

[103] *Round Table on Coexistence: Rapporteur's Report on Session2: Oilseed rape.* Jeremy Sweet, NIAB, UK. (http://europa.eu.int/comm/research/biosociety/pdf/rt_oilseed_rape_rapporteurs_%20report.pdf)

[104] Technical workshop at Central Science Laboratories (CSL) York, given to AEBC coexistence subgroup 19 September 2002. http://www.aebc.gov.uk/subgroups/consumer_choicemeetings.

[105] GM Science review, First report, part 7.2.2, p.200.

97. For *oilseed rape*, seed dropped in or around a field when harvesting a GM crop could survive and germinate to become GM volunteers in the next (non-GM) crop in that field or nearby. Research published in October 2003[106] modelled a typical rotation of winter oilseed rape over a period of 18 years. It indicated that after a GM rape crop was grown in a field, a threshold of 1% in a subsequent non-GM oilseed rape crop could only be met within five years if GM volunteers are rigorously managed, with all being destroyed before they set seed. The authors of the research note that "given that impurities also arise through sown seed and by gene flow between fields, thresholds of this order will be difficult to achieve in general farming practice"[107]. If no action was taken, the modelling predicts that the adventitious presence level from the feral plants would take 16 years to fall below 1%[108]. However, farmers would in most cases be expected to be motivated to control volunteers. Outside the cultivated land environment, the establishment and persistence of herbicide tolerant GM feral plants is limited in natural habitats[109], as the herbicide tolerant trait confers no competitive advantage over wild relatives and the rape plants are quickly outcompeted by wild plants.

98. Oilseed rape volunteers (GM or not) require more work to control on organic farms because use of herbicides is not permitted. Mechanical or manual weed removal is used instead. It could be that populations of GM volunteers would appear on organic farms, which could work against minimisation of adventitious presence in organic oilseed rape, if GM cropping had become widespread[110]. However, assuming adventitious presence thresholds remain as they are, there would be a strong motivation for organic farmers to remove such GM volunteers.

99. For *beet*, there would be a problem if bolters[111] were not removed from GM beet and remained to set viable seed, either by self-pollination or via out-crossing with other flowering beet varieties or with their close relative sea beet, producing weed beet which will then set seed in following years, some of which may be viable.

100. Weed beet would need rigorous control in any GM crop production. It can be argued that a farmer with more than a minimal number of weed beet plants in a particular field should not be eligible to purchase GM beet seed to plant in that field; others contend that GM beet could usefully be grown in weed beet infested fields as the only effective treatment for weed beet[112]. Good farming practice requires the removal of weed beet and bolters to prevent any adverse effect on the productivity of the crop and hence its profitability.

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[106] *Final report of the Defra project: Consequences for Agriculture of the Introduction of Genetically Modified Crops RG0114*, GR Squire and GS Begg, August 2003.

[107] GM volunteers are more likely to occur when land planted with a non-GM crop has previously been planted with a GM crop. It would therefore be important to know the history of particular plots when planning to grow non-GM or organic crops.

[108] The research model used will now be tested in a new project against independent data gathered from field experience on volunteer persistence. Results expected soon of gene flow studies carried out at FSE sites will give further indications of how well collectively volunteer control and other measures worked on a whole-field basis, though not volunteer control specifically.

[109] *Transgenic crops in natural habitats*, Crawley, M. J., Brown, S. L., Hails, R. S., Kohn, D. D. & Rees, M. (2001), Nature 409, 682-683.

[110] This scenario was presented at the European Commission roundtable on coexistence in April 2003.

[111] Growth on the plant which leads to flowering if unchecked.

[112] Farmers at the coexistence workshop supported this second option. In that case the farmer would have to be rigorous in removing any surviving weed beet or bolter from the field and the field margins before flowering.

101. *Maize*. Volunteers from maize do not occur in the UK because maize does not survive the winter here.

102. *Herbicide tolerance and control of volunteers*. Volunteers are normally controlled by allowing the seed to germinate and then cultivating[113] the field or spraying it with an appropriate herbicide to which the GM volunteer is not tolerant. If a GM variety had crossed with a non-GM variety or with a weed, and the resulting seed germinated as a volunteer in the succeeding crop, that too would require the use of an herbicide to which the GM variety is not tolerant. This could be an agronomic and environmental (rather than a coexistence) problem to some extent for non-GM crop production if the herbicide to which the GM crop is tolerant is the one which a farmer would normally use (for example glyphosate). The farmer would not be in a position to recognise in the first instance that he needed to use a different herbicide, and so might need to spray more than once or decide as a precaution to use more than one herbicide at the outset.

103. A further agronomic problem might develop if more than one form of herbicide tolerance was available in a crop species. This could give rise through cross-pollination to volunteer crop plants or compatible weed varieties which might develop through sequential cross-pollination in succeeding generations ("gene stacking") to produce plants with multiple resistance to herbicides. Other herbicides could be used, but farmers could face problems if this became widespread and in consequence a range of herbicides become redundant in respect of these weeds or volunteers[114]. This may suggest that different GM crops of the same species with differing herbicide tolerances should be separated, as well as GM crops being separated from non-GM crops[115]. For these and other reasons, English Nature has recommended that attention be given to developing gene use restriction technologies (GURTs) to minimise gene flow to wild relatives.[116] An alternative approach could be for ACRE not to recommend for release varieties which could lead to disadvantageous gene stacking in other varieties that have already been released. We disagree on the question of whether herbicide tolerant gene stacking would constitute significant agronomic problems.

Wild populations of crop plants

104. Oilseed rape seed is so small that it can leak through tiny gaps in a farm trailer or lorry, resulting in spillage of seed around the farm or on road side verges that could germinate to lead to feral populations of volunteer plants and risks of cross-pollination with the next season's non-GM oilseed rape crops. Oilseed rape survives more easily in the wild than many other crops, although it is not thought to form persistent populations[117].

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[113] The farmer's equivalent to the gardener's technique of hoeing.

[114] *Gene stacking in herbicide tolerant oilseed rape: lessons from the North American experience*. English Nature research reports No 443 (2002). The GM Science review stated that 'Regulators will have to continue to be mindful of the possible consequences of gene-stacking' (p.213). ACRE have stated that they will continue to do so in assessing case-by-case applications for Part C release.

[115] ACRE would take the potential for this type of gene stacking into account when considering granting approval for a new release.

[116] But there are practical and socio-economic difficulties with GURTs: see paragraph 119 of the report.

[117] Crop plants, which have been bred for particular qualities and generally need to be carefully tended if they are to thrive, are generally less adept at surviving in a natural environment than wild plants

105. Avoiding significant loss of the crop during transport is of course in farmers' economic interests. But to minimise the risks, if significant feral populations of suspected GM rape did develop near other crops, then the wild plants should be mown when flowering (i.e. while easy to spot) but before setting seed, to prevent cross-pollination with nearby crops (although this would be at a low rate). Realistically, only individual organic or non-GM farmers would be likely to have a sufficient direct interest in doing this, and only then for feral populations relatively close to their farm.

106. Some conventional oilseed rape feral populations exist within pollen distance contact with oilseed rape fields. So feral GM populations which became established following commercial growing of GM crops would be a source of adventitious presence. But because feral populations are small in relation to fields of GM crops, and tend to be outcompeted by wild plants in natural habitats, adventitious presence from feral GM crops would be expected to be at low levels[118].

Gene flow via wild relatives

107. Gene flow via wild relatives seems unlikely to be a major issue *in relation to coexistence*. Were commercial growing of GM crops to occur, hybridisation with wild relatives[119] could potentially lead to the transfer of the transgene into compatible wild relatives and ultimately back into a non-GM crop[120]. Transfer to wild relatives could affect organic farmers whose land might have to be decertified if it had on it plants with a GM content, if such weeds were detected and not removed, and *if* organic certification bodies adopted a policy of decertification in such circumstances. It could also lead to farmers having to be more rigorous in the control of potentially compatible weed species on or close to the farm which might mean incurring some extra costs, but would be compatible with good farming practice. The two principal wild relatives of oilseed rape are wild radish and wild turnip. Sea beet is the only wild relative of cropped beet. Maize has no compatible wild relatives in the UK.

108. Pollen transfer from neighbouring GM crops, volunteers, the seedbank and contaminated seed each seem likely to be more significant causes of adventitious presence than gene flow from wild relatives, so long as the populations of GM hybrids remain relatively small. If they or wild crop populations became significant in size in particular localities then there could be a new need for farmers to eliminate such plants as part of the package of measures to minimise levels of adventitious presence in crops.

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[118] *Quantifying landscape-scale gene flow in oilseed rape* Defra research project RG0216 (2003), p.41

[119] Oilseed rape can form hybrids with wild turnip, so if GM oilseed rape were commercialised, it similarly would behave similarly. A recent study has indicated the scale of present hybridization. (*Hybridization between Brassica napus and B. rapa on a National Scale in the United Kingdom*, Mike J. Wilkinson, Luisa J. Elliott, Joël Allainguillaume, Michael W. Shaw, Carol Norris, Ruth Welters, Matthew Alexander, Jeremy Sweet, and David C. Mason. Published online October 9 2003 10.1126/science.1088200 (Science Express Reports). The study infers that 'widespread, relatively frequent hybrid formation is inevitable from male-fertile GM rapeseed in the UK. Roughly 1 in 10,000 *B. rapa* plants found in wild populations would be hybrids. 55,426 individual wild relatives of oilseed rape growing in and around FSE oilseed rape plots were tested to determine whether the herbicide tolerant trait had been passed on. No evidence was found that any wild relative had inherited the herbicide tolerant trait. However, the most likely wild relative with which oilseed rape would hybridise - wild turnip (*Brassica rapa)* - was not found growing in or around any of the (limited number) of FSE sites and so could not be tested. (*Gene Flow from Rape Plants in the Farm Scale Evaluations*, C Boffey and R Daniels, CEH, 2003.)

[120] In the case of oilseed rape or (badly managed) beet.

Mixing seed or grain

109. Adventitious presence in the crop leaving the farm may be caused if the output from GM crops is inadvertently mixed with the output from non-GM crops. The SCIMAC guidelines set out particular measures which farmers growing GM crops were to follow to minimise this:

- clean all seed drills before and after use for a GM crop
- clean all equipment to be used in harvest before and after use for a GM crop
- clean all storage areas before and after use for a GM crop
- store all GM crops separately from non-GM crops
- inspect all vehicles to be used for transport off the farm both for cleanliness and for security (to prevent leaks)
- throughout, clean up any areas of seed or product spillage
- maintain a full set of records.

PART 2.3 WOULD COEXISTENCE BE PRACTICABLE?

110. Delivering consumer choice were GM crops to be commercialised will depend in large part on practical considerations at the farm level. Having considered the critical control points for adventitious presence on the farm, we considered whether and in what circumstances coexistence might be possible in practice. Our analysis and conclusions about possible ways to deliver coexistence are inevitably provisional, because there are many factors involved and considerable uncertainty about how they would interact and their combined effect on coexistence.

111. As well as flagging up the uncertainties around conclusions on the practicability or otherwise of coexistence, it is important at the outset of our detailed analysis to reiterate that this report does not assume that commercialisation of GM crops will proceed. Banning all commercial production of GM crops in the UK for a set period or permanently would require a renegotiation of the European regulatory framework if the ban was on grounds other than environmental harm or human safety. A ban is the option preferred by some stakeholders. In this report we have examined whether coexistence would be practicable and what the other implications might be were commercial cultivation to proceed.

Something rather than nothing would be needed

112. As a starting point, we are agreed that if commercialisation went ahead, it should not be on a completely *laissez faire* basis i.e. with no measures in place designed to facilitate coexistence. A *laissez faire* approach would meet the criteria of preserving choice, commanding broad support and minimising disputes, only if coexistence could be achieved without any changes to present farming practice.

113. Although it is impossible to be definitive in this, as with other conclusions, it seem probable that introduction of GM crops with no rules requiring specific farming practices might well in time make successful coexistence between GM and other crops impossible for some crops in many circumstances and more difficult for other crops, thus potentially restricting choice for consumers and farmers.

114. It would follow that disputes between farmers would be likely. A *laissez faire* approach would moreover run counter to the general acceptance among most stakeholders, including proponents of GM crops, that if GM crops are grown commercially, it makes sense to introduce them in accordance with best farm management practice, promoting good stewardship of the technology and helping farmers meet market demand for non-GM as well as GM produce. A *laissez faire* approach would also sit strangely with the recognition in forthcoming European regulation that appropriate measures should be taken by Member States to promote coexistence.

115. *Laissez faire* is therefore not a realistic or generally acceptable option. The question is whether any set of arrangements could be expected to deliver coexistence successfully, and to what extent; and whether in view of the uncertainties around the data, we can draw satisfactory conclusions about what might work.

Setting aside less promising possible solutions

116. We set out below a number of possible solutions which we ruled out based on the criteria for considering solutions we set out in Part 1.

117. *Controlling the commercial planting of GM crops through the land use planning system* might initially seem attractive. However, we are advised that present planning law could not be used in this way: once land has been zoned for agricultural purposes, planning law does not control the type of agricultural use made of it[121]. To seek to amend planning law would be an unwieldy and disproportionate solution.

118. *Compulsory regional zoning of GM crops* would be contrary to EU law, except on grounds of a particular environmental risk to the area in question, as the recent Austrian case has highlighted (although the decision is being appealed)[122]. Around ten other European regions, including Wales, and regions in Italy, France and Germany are pressing for the tightest possible coexistence measures, including GM-free zones. Despite the legal ruling a number of UK County Councils and other authorities have as signs of political intent declared their areas 'GM free zones'. Compulsory zoning would significantly limit some farmers' freedom of choice, and it would not be straightforward to operate (requiring the establishment of buffers between zones, and the monitoring of volunteers from long-distance transport of seed and of unauthorised growing within the non-GM zone). Some of us would not rule out the possibility of encouraging voluntary zoning agreements in some circumstances – a possibility recognised in the European Commission's coexistence guidelines. Others of us do not think encouragement would be appropriate: take-up of GM crops and any question of local agreements should be left to the market and local farmers and producers to determine; and compulsory zoning, aside from legal considerations, as an unfair and artificial limitation on access to GM crop technology. Farmers would still be free to make local voluntary agreements arrangements in response to market conditions.

119. *Gene Use Restriction Technologies* (GURTs) could in theory be used to limit cross-pollination from GM crops and GM crop plant volunteers. But technical developmental work in the plant breeding industry has not focussed on using GURTs for the purposes of coexistence. This is due in part to the opprobrium heaped on the suggestion of using such 'terminator' technologies – particularly in relation to developing countries – and the fact that in developed countries, including the UK, there is considerable use of farm-saved seed. UK seed companies accordingly would be expected to face some mistrust from farmers if marketing GM varieties containing GURTs in crops where seed-saving is commonplace[123]. As a technical

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[121] In a legal challenge to the FSEs in Scotland, the argument was made that they constituted a change of use of the land from agricultural purposes to research and development: the Court rejected this.

[122] European Commission ruling of 2 October 2003; the regional parliament of Upper Austria announced on 4 November 2003 that it would appeal against the ruling to prevent a ban on GMOs in the region. *Control of GM products in the EU, and the possibility of "GM-free" zones under Article 19 of Directive 2001/18/EC*, Defra, 21 February 2003.

[123] In the UK this includes oilseed rape and wheat.

solution to coexistence, GURTs would probably be some years away, even if there emerged a commercial interest in its development for this purpose[124].

120. *Permitting a higher statutory level of adventitious presence of GM material in non-GM crops* would obviously make coexistence easier to achieve. But for non-GM crops this approach is not achievable within the constraints of EU legislation (where the level for non-GM products is defined) now agreed by the European Council, Parliament and Commission, following long and hard negotiations. Reopening that debate again in the absence of compelling new data from any practical experience of commercial cultivation of GM crops in the EU would seem to have little to recommend it. We discuss the question of self-imposed non-statutory thresholds, particularly 0.1%, below.

Crop management protocols to minimise adventitious presence

121. We have explored whether and how farmers might implement measures to reduce adventitious presence sufficiently to achieve coexistence and preserve consumer choice. The practical measures needed to combat adventitious presence from all these potential causes could be described as crop management 'protocols'. Would following such protocols deliver coexistence?

122. The components of a crop management protocol would include:

- separation distances between GM and other compatible crops, which would be expected to vary from crop to crop, and in some cases between different varieties of crops[125].
- other measures relevant to the crop in question, depending on its particular characteristics (set out in more detail for the FSE crops in Annex C)
- measures common to all crops (e.g. separate storage on the farm, record-keeping, etc).

If protocols were to be a realistic solution to the question of coexistence there would need to be a combination of separation distances and other measures that could be expected to meet the desired threshold for adventitious presence in the vast majority of cases, while not being impracticable for farmers to implement. Separation distances are only one measure to reduce adventitious presence and not always the most important one. Consequently, farmers growing non-GM or organic crops, particularly to thresholds lower than 0.9%, would need to take measures to minimise adventitious presence of GM material in their crops, for example by controlling volunteer plants carefully and cleaning machinery before harvesting crops, as well as the farmer growing the GM crops observing separation distances and taking other measures.

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[124]But use of GURTs would be much more likely – indeed might well be a requirement – of any pharmaceutical production using GM plants, where farm-saved seed would not be an issue and outcrossing potentially a health and safety matter as well as a possible negative economic impact on other farmers' crops.

[125] A detailed account of the separation distances used in the FSEs and suggested by the results of recent relevant research can be found in PG Economics Ltd, *Consultancy support for the analysis of the impact of GM crops on UK farm profitability*' (prepared for the Strategy Unit of the Cabinet Office, April 2003: forthcoming UPDATE).

123. There are different views on how different factors would interplay in farm conditions and consequently whether coexistence would be practicable, which we will go on to explore. The Science Review concluded that, "Political decisions, market forces and other pressures will ultimately decide whether coexistence of different farming systems is practical, and in particular what thresholds are set for GM presence in crops and foods labelled non-GM. Uncertainty surrounds the way in which different factors determining coexistence will combine at commercial scales (i.e. the real-life consequences of the combination of unintended presence in seed, cross-pollination, and the contribution of volunteers). For some crops this may be relatively straightforward to manage, for others it may be difficult without significant changes to current practices."[126]

Seeking to meet a threshold of 0.9% for crop production

124. We examined what sort of crop management measures might be expected to be included in protocols to meet a threshold of 0.9% for the three FSE crops, if protocols were developed on the basis of the FSEs and existing data from certified seed production and other relevant agricultural production. The results are set out in table B.

125. Separation distances would need to be set in the light of the best available data and in the light of other factors impinging on gene flow, were protocols to be implemented. Research published in October 2003 on gene flow from GM crops suggested smaller separation distances for GM maize than those in the FSEs[127] and found that the amount of pollen-mediated gene flow in oilseed rape[128] confirmed that relatively small separation distances could reduce impurity through gene flow to less than 0.1% but that, primarily due to the action of insects, 100% purity cannot be maintained by geographical separation[129]. Data on adventitious presence levels from the other FSE crops in addition to that published on maize is expected soon.

TABLE B. POSSIBLE CROP MANAGEMENT MEASURES FOR PROTOCOLS TO MEET A THRESHOLD OF 0.9% FOR THE THREE FSE CROPS.

Beet (sugar and fodder)
Separation distance for crop production
Probably relatively small. The separation distance of 6m in the SCIMAC guidelines for the FSEs was intended simply to allow the operation of farm machinery, not to deal with cross-pollination, because sugar beet is normally harvested before flowering. But separation distances would depend on judgements about how effective bolter and weed beet control on GM plots would be.
Farming measures
• strict control of bolters and weed beet • cleaning of all farm machinery used to sow or harvest the crop

[126] GM Science Review Panel, First Report, p25 (executive summary).
[127] *Monitoring gene flow from GM crops to non-GM equivalent crops in the vicinity. Part 1: Forage Maize* Defra Research Project EPG1/5/138 (2003).
[128] Fully fertile rape, not varietal associations, which the report recommends need specific consideration. And of course, gene flow from pollen, as noted earlier, is only one possible source of adventitious presence.
[129] *Quantifying landscape-scale gene flow in oilseed rape* Defra research project RG0216 (2003).

- separate handling, and storage of GM beet, cleaning GM storage areas afterwards
- cropping interval of 4 years (although if a field is badly infected with weed beet the grower should widen the rotation to 6 or 7 years). More than one year's production of GM beet in a weed beet-infested field should not be permitted and then only when linked to an ongoing eradication programme.
- avoid sowing early (to help to minimise bolters)

Possible additional measure

- beet seed is already sold pelleted and coated. Coating colours could be used to allow GM seeds to be spotted easily if accidentally mixed with a non-GM seed lot.

Oilseed rape

Separation distance for crop production

- For fully fertile oilseed rape, a separation distance of 50m for conventional crop production (more for Varietal Associations[130], where the extent of cross-pollination is uncertain) was employed in the FSEs (for a 1% threshold). Research published in October 2003 found that the amount of pollen-mediated gene flow in oilseed rape[131] in terms of separation confirmed that relatively small separation distances could reduce impurity through gene-flow to less than 0.1%, but due to the action of insects primarily, 100% purity cannot be maintained by geographical separation[132]. Data on gene-flow from cross-pollination from the other FSE crops in addition to that already published on maize is expected soon.

Farming measures

- strict control of volunteers
- cleaning of all farm machinery used to sow or harvest the crop
- separate handling, and storage of GM rape; cleaning GM storage areas afterwards.
- seed spillage on and off the farm carefully monitored
- special care with farm-saved seed

Maize (forage and grain)

Separation distance for crop production

Separation distances of 80 and 130m (for forage and grain maize respectively) were employed in the FSEs (for a 1% threshold). The distances set would depend on the varieties of maize being used. Research carried out during the FSEs suggested that 24.5m would have been sufficient to achieve 0.9% and that 80m was sufficient to ensure cross-pollination levels were below 0.3%, although in a few cases these levels were exceeded at these distances..

Farming measures

- high degree of seed purity needs to be guaranteed
- thorough cleaning of farming machinery
- possible planting of barrier rows to minimise cross-pollination.

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[130] Whose use is declining, even in Scotland.

[131] Fully fertile rape, not varietal associations, which the report recommends need specific consideration. And of course, gene-flow from pollen, as noted earlier, is only one possible source of adventitious presence.

[132] *Quantifying landscape-scale gene flow in oilseed rape* Defra research project RG0216 (2003)

126. It seems to us that measures along these lines should be *practicable for farmers growing GM crops to follow*, and that they could reasonably be included as requirements in protocols to be observed as a condition of growing GM crops[133].

127. But while protocols with these measures look practicable to implement for farmers, *would they reliably deliver a 0.9% threshold through time*? If coexistence were to be successful, that would mean that breaches of these thresholds would be rare.

128. There are two aspects to this: is it technically feasible; and would the measures to achieve it be followed in practice with sufficient rigour? There are divergent views among us on both counts.

129. Some stakeholders are confident that protocols would work, because they would build on existing best practice. They cite existing experience in seed production and the production of HEAR rape, and during the FSEs. We have noted the measures in the SCIMAC guidelines and that there was no instance in the four years of the FSEs, which involved some 260 trial sites and 277 organic farms classified by the organic sector as 'at risk', of organic status being lost through adventitious presence. We have also noted that the significance for whether coexistence in commercial production would be practicable of the lack of failures in the FSEs is disputed by some stakeholders. They consider that the various contributing factors of adventitious presence can in principle in most circumstances collectively amount to lower than 0.9% thresholds, providing crop management protocols of the sort outlined above are followed. Many of the measures that would be required of GM farmers in respect of coexistence are in any case being increasingly required in conventional production. The National Farmers Union is confident that a system of protocols could work in principle to facilitate coexistence and recommends this as a way forward[134].

130. Others are more sceptical, even about the 0.9% threshold, because of the lack of experience of growing commodity crops to such a strict threshold, perceptions of experience overseas; and the many uncertainties around how the situation would develop in the field. They also note that for seed production, separation distances are relatively large; and that the tolerances in HEAR production are significantly higher (2%) than the 0.9% threshold. They question whether in fact for 0.9% there is even in principle reliable evidence that the various factors contributing to adventitious presence can cumulatively be kept sufficiently low, at least in some crops.

131. They are moreover not convinced that farmers would follow voluntary protocols sufficiently thoroughly. The farmers' organisation, *farm*, in a submission to the AEBC, cited examples of where voluntary protocols have failed: pesticide over-spray, the need to introduce legislation to prevent straw-burning following the failure

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[133] There might need to be separate national protocols for England, Scotland, Wales and Northern Ireland (taking account of any additional cross-border issues in the latter case) to take account of agronomic factors, or there may be political differences on policy on GMs that lead one party to seek more stringent measures. Protocols might also need to allow for relevant regional differences, for example in climate or farming practices (e.g. smaller field sizes in the west of England or the short interval between harvest of one crop and sowing of the next, and use of varietal associations of oilseed rape in Scotland). But they would be broadly similar.

[134] NFU policy statement on coexistence, October 2003, http://www.nfu.org.uk.

of a voluntary code, and sheep dip disposal[135]. Consistent with this view, a recent US Department of Agriculture survey[136] found that almost 20 percent of US farmers surveyed had failed to comply with a regulatory requirement to ensure there are refugia (to prevent build up of insect resistance, not to promote coexistence) around Bt corn fields.

132. They also point to the lack of an adequate economic incentive for the farmer growing GM crops to minimise adventitious presence in their neighbours' crops. Many might do so as good neighbours. But there is no market driver for the farmer growing GM crops to seek to follow crop management protocols rigorously to minimise adventitious presence in other farmers' crops. This is not in itself a fatal criticism of crop management measures but points to a need for protocols for growing GM crops to be mandatory. This would meet the points made about breaches of voluntary protocols.

133. We all agree that in there is considerable uncertainty over what would happen in commercial production. A lot of factors are involved. It would depend on the crop. It would depend on the behaviour of farmers. It would depend on market conditions. Having considered the available information, and recognising the uncertainties noted above, our provisional assessment on balance is that for the first generation of GM crops (oilseed rape, maize and beet), crop management protocols *may* be capable of delivering successful coexistence at 0.9% for maize and beet and perhaps also oilseed rape, but rape would be likely to be more difficult than the other two. But this is very much a provisional view: more evidence is needed of what would happen in practice.

Seeking to meet a threshold of 0.1% for crop production

134. What about the prospects for coexistence at a 0.1% threshold, for those organic and possibly other farmers who expect to work to that level of purity?

135. At present some 4.1% of UK agricultural land is in organic production or in conversion[137]. A report by PG Economics gives the following figures for current organic production in 2002 of the crops which were included in the FSEs:

- Oilseed rape: about 200-250 ha (0.05% of total UK crop)[138];
- Maize: about 500 ha (0.5% of total crop), all forage maize, though in recent years around 40 ha of organic sweetcorn has also been grown[139];
- Sugar beet: 518 ha, which would produce about 3000 tonnes of white sugar (0.3% of total UK sugar production)[140].

136. The lower the level of adventitious presence it is desired to achieve, the less likely it is that any combination of measures can deliver the desired result. With a view to meeting a threshold of 0.1%, we have looked at what degree of certainty

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[135] *farm* evidence to AEBC, May 2003
[136] *Corn and Biotechnology: Special Analysis*, USDA, 11 July 2003 (www.usda.gov/nass/pubs/biocorn.htm)
[137] More than 4000 holdings. Defra statistics.
[138] PG Economics Ltd, *Consultancy support for the analysis of the impact of GM crops on UK farm profitability'* (prepared for the Strategy Unit of the Cabinet Office, April 2003: forthcoming), p61.
[139] *Ibid*, p84.
[140] *Ibid*, p70.

could be achieved by combining the farming measures specified in Table B with more precautionary separation distances.[141]

137. Recognising the need for a combination of measures, the Soil Association has approached the issue through a risk matrix, including separation distances of 1 km for beet, 3 km for maize and 6 km for oilseed rape[142]. These distances are based on a literature survey by the National Pollen Research Unit[143], relating to the distance by which pollen can travel by wind and insect vectors. They would probably pose some difficulties for some farmers who wished to undertake GM cropping, as these radii could encompass a relatively large number of organic fields. The National Pollen Research Unit recommendations are based on "very low risk distances" and not designed to meet a 0.1% threshold as such but rather to seek to avoid any GM adventitious presence.

138. In the FSEs, a lower separation distance (200m) between the GM crop and organic counterparts was set for maize[144] and oilseed rape; this is also the separation distance recommended in a recent Danish study[145]. For beet in the FSEs, the separation distance used in seed production (600m) was adopted[146]; the Danish study recommends 50m as adequate. Other studies, notably the European Commission Joint Research Centre Study[147] suggest that for maize, oilseed rape seed and potatoes, although in some cases existing farming practices would be sufficient to achieve 1%, successful coexistence at 0.1% would be very difficult, and may be virtually impossible to achieve. Research on maize in the FSEs indicated that to get below 0.1% from cross-pollination, 257.7m would be needed[148].

139. A threshold of 0.1% *might* be met quite often, at least initially when GM and organic cropping of compatible crops would be likely to remain limited and because where there was a risk it may often be possible for very local arrangements to be worked out satisfactorily. In the longer-term, it again depends in part on the crop. It would also critically depend on how many non-organic farmers are, in response to market demand, working to 0.1% too. We would expect significantly greater problems in trying to meet a 0.1% threshold than for 0.9% with crop management protocols, particularly for oilseed rape[149] but also for maize; albeit less so for beet, provided there was strict management of GM crops, especially of weed beet and bolters.

140. It is not *certain* that it would always be met even with heavily precautionary separation distances such as those set out by the National Pollen Research Unit,

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[141] Given the main causes of adventitious presence in oilseed rape and beet, rigorous observance of on-farm measures would be more important than separation distances.

[142] PG Economics Report, p118.

[143] Rob Treu and Jean Emberlin, *Pollen dispersal in the crops maize, oilseed rape, potatoes, sugar beet and wheat: evidence from publications*, a report for the Soil Association from the National Pollen Research Institute, January 2000.

[144] The distance for maize takes into account the fact that the maize used in the FSEs (T25) is heterozygous, so only half the pollen carries the GM trait.

[145] Karl Tolsrup et al, *coexistence of genetically modified crops with conventional and organic crops – report from the working group*. Danish Institute of Agricultural Sciences. 10 January 2003.

[146] We understand that this distance related to old varieties which were open pollinators and are no longer used.

[147] *Scenarios for co-existence of genetically modified, conventional and organic crops in European agriculture*. AK Bock, K Lheureux, M Libeau-Dulos, H Nilsagard and E Rodriguez-Cerezo, 2002.

[148] Defra Research project EPG/1/5/138

[149] Although as noted elsewhere, oilseed rape - unlike in conventional arable production - is not at present an important organic crop.

given that adventitious presence from cross-pollination is only one factor and not necessarily the most important. Some of us are very sceptical that this would be a sustainable practically deliverable threshold if GM crops were being grown widely and taking account of the practical difficulties of accurately testing crops to this level on the farm; as we note in Annex B, reliable testing to the 0.1% threshold requires careful adherence to sampling methodologies and would present a significant practical challenge, aside from the issue of the costs of testing.

Seeking to meet thresholds in seed production

141. Maize seed is not produced in the UK. There is some production of oilseed rape seed and a little beet seed is grown.

142. As noted earlier, seed thresholds have not been fixed yet in Europe and are the subject of continued discussion. There is considerable experience of seed production to high standards of purity in the UK, often involving large separation distances. It would be expected that seed production could become more challenging for some crops (particularly oilseed rape) were GM cultivation to become widespread, but GM cropping at this stage would seem unlikely to rule conventional seed production out.

143. Organic seed production to 0.1% thresholds would be expected to prove more challenging – if demand for organic seed for oilseed rape (or some future crops) increased significantly (at present the demand for organic oilseed rape seed could be met easily because the quantity is so small – 0.5 tonnes[150]). Again, if there is market pressure on non-organic farmers to get to a 0.1% or other very low threshold, this could become a bigger problem than one simply for organic farmers.

Seeking to meet a threshold of 0.9% for honey

144. No organic honey is produced in the UK[151], so the relevant threshold for GM content would be 0.9%. The final product would always meet that threshold easily: the actual GM content of honey would be minuscule, because its total pollen content is very small[152]. The issue relates to its ingredients. Because bees forage widely, there is a sense in which all the contents of honey are adventitious – and because it is not feasible to trace the flight of individual bees, there would be no way of knowing the source of the sugar in their honey. Although it has been shown that most of the content of honey comes from within 500m of the hives, bees do range further, up to around five or six miles.

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[150] "Based on 2002 plantings of oilseed rape in the UK (200-250 hectares), the area of seed required to service this is only 0.5 hectares, which could be supplied by one specialist grower (i.e. one field of crop required). It would therefore not be difficult to site such a specialist enterprise in a region where there is limited planting of commercial varieties (e.g. Wales, SW England) and hence minimise the possibility of adventitious presence of GMOs occurring. This siting of specialist seed enterprises in remote areas, to deliver crop isolation and maximise seed purity is not new – it is already applied in conventional seed production, most notably in the potato sector" PG Economics report, p. 37-38.

[151] For reasons unrelated to GMOs.

[152] The Scottish Executive, in its 2003 response to the Health and Care Committee of the Scottish Parliament's report on GM Crop Trials and Health (2003), stated that, "Research carried out on the presence of pollen from GM crops in honey concluded that consumers would ingest no more than 5 nanograms of transgenic protein from a 500g jar of honey - this is one part in a hundred thousand million, equivalent to one crystal of sugar in 28,000 1 kg bags. In 1999, the ACNFP endorsed its earlier advice issued in 1991, that the presence of very small quantities of GM pollen in honey does not present a safety risk to consumers."

145. Faced with a relatively small number of FSE sites, the British Beekeepers Association adopted a policy of a six-mile separation distance of hives from GM trial sites. If GM crops were produced on a commercial scale this might become impracticable in some locations. Beekeepers should be consulted in the design of coexistence arrangements.

PART 2.4 COULD PROTOCOLS WORK WITHIN THE LIKELY FUTURE PATTERN OF UK AGRICULTURE?

146. In Part 2.3 we looked at and rejected, for various reasons, a number of possible solutions to minimise adventitious presence were GM crops to be introduced. The reasons for rejecting them were variously practical or technical, or legal, or that they would have no chance of commanding broad agreement among key interested parties. We noted that if coexistence were to be successful, that would mean that breaches of thresholds would be rare.

147. We concluded that observance by GM growers in cooperation with their neighbours of carefully defined measures may be able to significantly reduce the amount of adventitious presence of GM in non-GM crops. But this is very much a provisional view: more evidence is needed of what would happen in practice, and whether coexistence is possible more generally is going to depend also on whether 0.1% can be delivered for organic farmers now, how many other farmers may be working to a 0.1% threshold, and future trends in UK agriculture in respect of these and other factors. We will go on to recommend an introductory period to test these factors out further.

148. In this part of the report we examine the possible impacts of future trends in UK agriculture. If the commercial production of GM crops were to proceed using crop management protocols, the detailed content of those protocols would need to be kept under close review and amended as necessary in the light of experience. But there would be little point in adopting this approach, even experimentally, if protocols could be ruled out as a practical option now in the light of foreseeable future developments.

149. We have therefore looked at the possible predictable changes in agricultural patterns in the UK. In looking at these changes we have kept in mind the Curry report's central recommendation that farmers must reconnect with their markets.

150. We have considered:

- the likely development of organic production
- whether non-organic farmers are likely to work to a 0.1% threshold
- the likely speed of uptake of GM crops if commercial production were to proceed
- other likely GM crops for which approval might be sought
- the likely production of crops for bioenergy

The likely development of organic production

151. In the context of the Organic Farming Action Plan[153], the Government supports a target of increasing the share of the UK organic market that is supplied by UK producers to 70% from the current level of 30%. The new administration in Scotland

[153] www.defra.gov.uk/farm/organic/actionplan/actionplan.pdf.

is committed[154] to implementing the Scottish Executive's Organic Action Plan to develop the infrastructure needed to increase the market penetration of organic products so that they meet at least 70% by value of overall Scottish consumer demand for organic products that can be sourced in Scotland[155]. The administration has said that it will increase the finance available for farmers in Scotland who wish to convert to organic farming. The Welsh Assembly Government has a target of 10% of agricultural production in Wales being organic by 2005. The Northern Ireland Rural Development Plan 2000-06 contains a target of 1,000 organic farms (30,000ha) by 2006, as compared with the present level of around 150 farms (5,000ha)[156].

152. The likely expansion of organic production raises two issues in relation to coexistence:

- to what extent will the organic production be of crops of which GM varieties might also be grown (resulting in a direct risk of adventitious presence)?
- could the commercial production of GM varieties cause problems for organic farmers even if the crops being grown were not the same?

153. On the first question the report by PG Economics[157] notes:

> "Although the [organic] sector has experienced rapid expansion, it remains a small part of UK arable crop agriculture. For example, the current area of organic wheat, oilseed rape and sugar beet account for 0.5%, 0.06% and 0.34% respectively of the total UK areas planted to these crops. Even if it was assumed that there was a substantial (e.g. fivefold) increase in the UK organic area planted to these crops in the next 5-10 years, the sector would remain small relative to total arable crop production. The number of (organic) farmers possibly affected would therefore be small relative to the total number of farmers in the UK. Many would not be producing crops for which GM alternatives are available (the primary reason why the majority of organic farms found to be within 6km of the FSEs were not classified as being "at risk" by the Soil Association). Also the area classified as being "at possible risk" would probably be very low. For example the category of crop identified as having the greatest possible risk of adventitious presence identified in the JRC study is winter oilseed rape *seed* production."[158]

154. We have heard evidence from organic farmers that fodder maize may become more important to organic livestock production. Organic producers often have difficulty sourcing sufficient organic feed. Organic fodder maize is estimated to cover

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[154] *Partnership for a better Scotland: partnership agreement*. May 2003. (http://www.scotland.gov.uk/library5/government/pfbs-02.asp).

[155] The targets are for Scottish organic products to grow in market penetration so that they can meet at least 70% by value (from a current level of 35%) of overall Scottish consumer demand for organic products which can be sourced in Scotland, as well as succeeding in the broader UK and international markets; and a doubling of the area of arable land and improved grassland in organic conversion or production, with a view to these areas comprising 30% of Scotland's organic area by 2007, against a current 15%. *Organic Action Plan*, Scottish Executive, February 2003. (http://www.scotland.gov.uk/library5/agri/orap-00.asp)

[156] Progress towards this target has been slowed by the effects of the foot & mouth crisis (during which inspectors could not visit farms) and by erosion of the organic premium price.

[157] *Op cit*, pp 37-38.

[158] It is also worth-noting the international nature of the seed business: most maize seed used in the UK is produced in France and central Europe (no longer from the US because the risk of adventitious presence is too high); and sugar beet seed used here is mostly from south west France and the Po Valley in Italy.

500 ha at present (out of a total fodder maize area of 100,000 ha). Even if organic production increased several-fold, it would remain proportionately a relatively small area. Demand for other organic cereal crops for use in animal feeds may increase over coming years, although there are no GM cereal varieties apart from maize available for cultivation at present. But, again, organic production would be expected to account for no more than a small proportion of the UK's cereal cropping area.

155. There is a small market for organic sweetcorn, which although it would appear not to have been satisfied from within the UK in 2003, could be produced here. It was estimated in 2001/02 that the UK market for organic sweetcorn was 374 tonnes[159]. Half of the demand that year was met from the UK, representing 38 ha of production. Organic sweetcorn production therefore would cover only a very small area even if UK production increased several-fold[160].

156. On the second question, even if the GM and organic crops being grown were not the same, there would be cases where a GM crop plant (or a weed which had crossed with a GM plant) would appear as a volunteer in a field planted with an unrelated organic crop. The organic certification bodies have not taken a view on this and we understand that at least one of them is seeking legal advice. If one or two such GM plants were harvested inadvertently with the crop and this counted in subsequent organic food or livestock production as 'use' of a GMO then it could cause problems in relation to organic certification of the crop. The conclusion that this scenario would represent 'use' seems somewhat strained, however, provided the number of such plants was minimal. Removing such plants would have to fall to the organic grower.

157. We expect that if commercial GM crop cultivation appeared likely, Government and the organic certification bodies would wish to clarify whether it would be *illegal* under existing organic legislation to use in organic livestock production animal feed or in organic produce an organic crop containing any degree of adventitious presence of GM or whether the provision in the organic regulation does in fact allow some such adventitious presence, as implied by the European Commission's coexistence guidelines; and whether the presence in an organic crop of a small number of weeds or volunteer containing a GM event would require decertification of an organic crop, field or farm.

158. Organic farmers' organisations or certifying bodies might decide upon regional zoning of some crops, impose extra separation distances on their own members (although both these measures would impose costs) or impose additional measures/protocols (e.g. using only crops with different flowering times to GM counterparts, avoiding sharing machinery with farmers growing GM crops) in order to minimise adventitious presence. One option for the organic certifiers would be not to withdraw certification where their member could show that he or she had taken every reasonable effort to minimise adventitious presence, even if a stray GM volunteer entered a crop (or indeed a marginal breach of the 0.1% threshold had occurred).

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[159] In a Defra-funded Henry Doubleday Research Association/Soil Association research project: *Organic Vegetables Update*, Chris Firth, 25 November 2002 (http://www.hdra.org.uk/pdfs/orgvegupdate.pdf).

[160] The PG Economics report does acknowledge that there might be more difficulty in ensuring coexistence between GM and organic production if GM agronomic traits were to be commercialised in the UK fruit and vegetable sectors (where the share of UK organic produce is higher than in the arable cropping sector). No GM agronomic traits applicable to fruit and vegetables grown in the UK are on the horizon for the next ten years.

The organic threshold

159. As we have noted earlier, there is also considerable argument about the *de facto* 'zero' threshold of 0.1% adopted by the Soil Association and others. We differ on the reasonableness in principle and in practice of trying to work to this threshold rather than the statutory non-GM threshold of 0.9%.

160. One view is that it is up to individual growers to produce a crop that meets the requirements of their purchasers, not for others to do so for them. Coexistence is about giving *all* farmers freedom to grow what they judge consumers and their markets want, not only organic and conventional farmers. Some of us believe that most consumers would accept that a 'zero' threshold is unachievable in practice and that 0.9% is a reasonable compromise. Seeking to put arrangements in place to meet a 0.1% threshold with a high degree of certainty would pose unreasonable and unacceptable burdens on farmers growing some kinds of GM crops. Coexistence arrangements should not be designed to accommodate this threshold, only the 0.9% threshold.

161. The 0.9% threshold was the subject of long discussion at EU level and was thought to be achievable with proportionate measures. It would impose some constraints on growing GM crops but these are not unreasonable and so are compatible with coexistence. The onus on taking measures on the farm to go the 'extra mile' below the statutory non-GM threshold to seek to achieve 0.1% should be the responsibility of organic (or indeed non-GM farmers) if that is what they believe their consumers are seeking. There is no objection to organic or other farmers aiming for lower than 0.9%, but the extra measures involved in order to try to do so should be for the organic farmer.

162. Those of us who take this view strongly suspect on the basis of the available evidence that successful coexistence at 0.1% would be unachievable if there were significant areas of GM crop cultivation, and so oppose setting up coexistence arrangements to aim to achieve 0.1% because it would raise unrealistic public expectations about what is likely to be deliverable. There is also a concern that accurate testing on the farm to this level, although theoretically possible, would be very difficult in practice. There is moreover a suspicion that the *de facto* 'zero' threshold of 0.1% is being used by some – though perhaps not all – interested parties as a way *de facto* to rule out the introduction of the option of growing GM crops, particularly given the declared policy of the Soil Association to oppose the production of GM crops in the UK. Placing a requirement on farmers growing GM crops to help other farmers achieve a threshold lower than the statutory 0.9%, especially 0.1%, is unreasonable and unjustifiable.

163. The opposing view is that organic producers are responding to consumer demand for as little GM material as possible in their food and that 0.1% is a rational, realistic and reasonable threshold to set in response to this consumer demand. Organic farming is established and growing and there is little or no appetite for GM products in the UK: the onus should be on GM cropping to take place, if it takes place at all, in a way that respects the 0.1% standard adopted in organic agriculture. The EU coexistence guidelines ought to recognise this.

164. Moreover, if consumers want to buy non-GM products at a low a threshold as is technically practicable, i.e. 0.1%, this option should be open to all farmers, not only those producing organic crops. The bottom line for is that given market

circumstances and consumer attitudes, we should not attempt coexistence without at the very least making compensation available for farmers suffering an economic loss in relation to a 0.1% threshold, for both organic and non-GM crops. Growing GM crops should be constrained as required to achieve that, including ruling out their cultivation altogether if necessary.

165. Where we are on common ground is that it will be necessary to investigate the extent to which the 0.9% and 0.1% thresholds are achievable in practice on the farm and what levels of adventitious presence are being found in non-GM and organic final products. We go on to recommend later in this report a programme of monitoring over a number of years to gather the necessary information.

Will non-GM farmers be seeking to meet a 0.1% threshold also?

166. It is unclear, however, whether it would only be organic farmers who are working to a 0.1% threshold, or some other threshold lower than 0.9%. For food products this will depend critically on consumer demand as mediated by the supermarkets. In turn, supermarket requirements will be strongly influenced by availability of product, competitive advantage and perceived consumer requirements. Only time will tell, but it seems to most of us, in line with the principle of enabling farmers to reconnect with their markets, that those farmers who do need to work to a lower level should have the opportunity to do so. Others of us accept that some farmers may wish to work to a lower threshold than the statutory one, but are clear that the onus should be on those farmers, rather than the GM farmer, to seek to achieve that.

167. Accordingly, some of us take the view that in any initial introductory period for growing GM crops, crop management protocols for GM growers should be designed to allow those farmers who do want to aim for 0.1% to do so. If market conditions do lead to cultivation of GM crops on a wide scale, as noted above, this will present particular challenges for maintaining seed purity at sufficient levels to attempt to grow crops to a 0.1% threshold.

168. Others of us take the view take the view, in line with EU policy, that farmers should able to choose the type of crops they wish to grow, and should not be prevented from the production of crops to the statutory 0.9% GM threshold. In particular a farmer wishing to grow for an export market or an industrial market accepting GM product must not be prevented unreasonably from doing so.

The likely speed of uptake of existing and possible future GM crops if commercial production were to proceed

169. As noted earlier, we have considered how quickly farmers in the UK might adopt GM crops if commercial production were to proceed. It seems likely that take-up would be gradual, not least because there would need to be time to produce sufficient GM seed for widespread planting, aside from consumer resistance which would be expected to significantly limit the extent to which farmers would choose to grow the first generation of GM crops for food and feed purposes in the next few years. The PG Economics report[161] points out that for most farmers the decision as to whether to grow available GM varieties would depend predominantly on their relative profitability.

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[161] *Op cit.*

170. Across the EU, demand for non-GM crops is greatest for those that go into the food chain, either directly or indirectly through animal feed[162]. It is impossible to predict how the overall market will develop, though the PG Economics report notes in particular a likely fall in the world market "base" prices for crops where there is a general world shift to cost-reducing GM technology[163].

171. Aside from market factors, most individual farmers would probably not switch entirely and immediately to GM varieties of the relevant crops, because they would want to test out how suitable the GM variety was for their particular farming circumstances. And the take-up of GM crops would also depend on their availability for planting. New varieties take time to come to the market place. GM crops might become available for commercial-scale growing in the UK (if their commercial cultivation were to be allowed) on the following timescale[164]:

GMHT forage maize	2005-2008
GMHT winter oilseed rape	2005-2008
Hybrid vigour and HT oilseed rape	2005-2008
GMHT sugar beet	2006-2008[165]
GMHT wheat	2008-2011
GM fusarium resistant wheat	2012-2014
GM potatoes (nematode resistance)	not before 2013.

172. The present market conditions in the UK and EU and the perceived state of public opinion suggest that any take-up of GM food and feed crops would be even slower than for conventional new varieties: many farmers might wait to see how their markets reacted to cultivation of GM crops. It is likely, therefore, that as noted earlier, that even if there were not a specified introductory period, market-take-up rates would in effect allow scope to see how coexistence measures worked in practice for these crops.

Other possible GM crops for which approval might be sought

173. In our horizon scanning work[166], we identified GM wheat and other grains, amenity grasses, potatoes and other vegetables and fruit as possible candidates for the next generation of GM crops, beyond the FSE crops, for which consent might be sought. A recent Danish study[167] has examined some of these, concluding that (for open-field production in Denmark):

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[162] Though the report notes that the strength of this demand depends on the price-sensitivity of final demand: so for example there is less concern about what cheap frozen chicken may have eaten.

[163] For example, it appears that by the end of 2001 the real price of soybeans had fallen by 1%-2%.

[164] PG Economics, *op cit*, pp 11-16.

[165] It was suggested at a stakeholder seminar that large-scale production of GM sugar beet could not start in a large scale in the UK until around 2009, even if there was approval now of the GM crop.

[166] *Looking Ahead: An AEBC Horizon Scan*, April 2002, outlined work underway in biotechnology research, particularly genetic modification, of possible agricultural significance. We assessed and described nearness to commercialisation in Part 3 (particularly paragraph 65 onwards) and Annex A (http://www.aebc.gov.uk/aebc/reports/reports.shtml).

[167] Karl Tolsrup et al, *Coexistence of genetically modified crops with conventional and organic crops – report from the working group*. Danish Institute of Agricultural Sciences. 10 January 2003.

- For barley, wheat, oats and triticale (taken as a group), since these species were largely self-pollinating[168], the most important sources of transmission of GM constructs would be through adventitious presence in seed, volunteers, and straw and crop handling. On this basis, keeping below thresholds of 0.9% or 0.1% with appropriate on-farm measures was thought to be achievable.
- Rye has more potential to cross-pollinate and separation distances of between 250m and 500m would have to be observed, as well as appropriate on-farm measures. (Rye is a minor UK crop.)
- For forage and lawn grasses, and for grassland legumes (clover, alfalfa) all of which are cross-pollinating, it was suggested that special measures would be needed to keep below 0.9% adventitious presence, and current information does not show whether a lower threshold could reliably be met (for animal feed – humans do not eat these crops).
- For potatoes, cross-pollination is possible, but the main source of transmission would be adventitious presence in seed potatoes, over-wintering volunteers (ground-keepers) as well as machinery and transport. To meet the thresholds, separation distances of some 20m are suggested, together with control of volunteers, cleaning of machinery, and, in the case of organic production, using only organic seed.

174. However, as noted earlier, the European Commission Joint Research Centre Study[169] suggested that for potatoes[170], although in some cases existing farming practices may be sufficient to achieve 1%, successful coexistence at 0.1% would be very difficult, if not impossible.

175. Overall, at this stage it is too early to say whether coexistence with possible future GM crops would be practicable, for the same reasons that there is uncertainty over whether it would be practicable using crop management protocols for the first generation of crops. It would depend in part on the crop[171] and the variety, as well as how the different contributing factors to adventitious presence would combine at a commercial scale, and the same uncertainties about how well protocols would be followed in practice. Consumer attitudes and market demand would be just as critical as for the present generation of crops. Equally, possible future GM crops do not offer grounds to rule out the possibility of trying crop management protocols as a possible means of promoting coexistence.

176. The same points about the relative difficulty of meeting different thresholds of 0.9 and 0.1% would also generally apply. Generic lessons learned from any commercial growing of GM crops in an initial introductory period and possibly thereafter should help inform decisions about future crops.

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[168] Triticale can cross-pollinate, so in addition a separation distance (perhaps 50m) would be needed.

[169] *Scenarios for co-existence of genetically modified, conventional and organic crops in European agriculture.* AK Bock, K Lheureux, M Libeau-Dulos, H Nilsagard and E Rodriguez-Cerezo, 2002.

[170] And for maize and oilseed rape seed.

[171] And we would emphasise that some non-food crops (particularly pharmaceuticals) might need a substantially different approach. It could be, for example, that because of the potential for outcrossing to wild relatives, it would be a condition of approval that GM plants sold to farmers/users were male sterile genetically.

The likely production of crops for bioenergy

177. A new EU Directive[172] requires all Member States to ensure that targets for the proportion of transport fuel consisting of biofuel are met by certain dates, starting with 2% in 2005 and rising thereafter by 0.75% per year up to 5.75% in 2010.

178. In the UK, the Energy White Paper[173] estimates that biodiesel and bioethanol could account for up to 5% of total[174] fuel use by 2020. The duty rate charged on biodiesel has already been reduced to below that for ultra-low sulphur diesel, and in the 2003 Budget the Chancellor announced a reduction for bioethanol compared with ultra-low sulphur petrol[175]. In addition, the production of biomass crops for renewable energy production is being promoted in UK and elsewhere in Europe. A key element in UK energy policy is for the proportion of electricity generated from renewable sources to increase.

179. To produce enough biofuel to achieve a 5% biofuel blend[176] in all transport fuels used in the UK, 800,000 to 1 million ha of land could be required. Assuming this to be a mix of biodiesel and bioethanol, the land usage would be made up of a combination of crops. Biodiesel can be produced from oilseed rape or from recycled cooking oil. In the US, maize is one of the major bioethanol crops. Bioethanol is traditionally produced by fermentation from crops such as wheat, potato and sugar beet. In addition, biomass crops, including willow and miscanthus are already being grown in the UK for renewable energy production. We understand that plant breeding companies are looking at the possibility of producing GM varieties of these and other biomass crops.

180. On the basis that consumption of diesel in the UK in 2000 was 19 billion litres, to substitute biodiesel at 5% would require 950 million litres of biodiesel. Of this, 115 million litres could come from waste oil. To produce the remaining 735 million litres from oilseed rape would require an area of 421,000 ha[177]. To put this into perspective, in 2002 a total of about 350,000 ha of oilseed rape was sown in the UK. In addition, 72,392 hectares of oilseed rape was grown on set aside land (which means that it was grown for non-food use). Although little hard data is available on the end-use, limited anecdotal evidence suggests that a considerable proportion of the set aside oilseed rape appears to go to Germany and, to a lesser extent, Spain for use as biofuel (there is at present little biofuel production in the UK).

181. If farmers judged that GM varieties of oilseed rape and sugar beet made the economics of producing biofuel significantly more viable, this potentially could mean very widespread cultivation of GM crops. GM crops grown for non-food purposes would need to be subject to coexistence measures because they would be a source

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[172] EC Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport.

[173] *Our Energy Future: creating a low carbon economy* (February 2003: Cm 5761). Energy policy is a reserved matter for the UK Government under devolution legislation.

[174] That is, not just fuel for road transport, to which the EU Directive is confined.

[175] Other measures are in train to make use of biofuels more attractive for power generation (Consultation on amendments to the Renewables Obligation (amendment) Order, DTI, August 2003 available at http://www.dti.gov.uk/energy/renewables/policy/rooamend.shtml) but transport biofuels in the short term look most relevant to the available GM crops. In time, GM varieties of other crops more suitable for power generation may be developed, depending on how the market develops.

[176] This is not a statutory percentage, but a commonly accepted level to blend with conventional fuel, contemplated for example in vehicle warranties. Most vehicles in the EU are capable of using a low biofuel blend without any problem.

[177] Assuming yields of 4 tonnes per hectare.

of adventitious presence in the same way as GM food and feed crops.

A precautionary initial period

182. A *laissez faire* approach to growing GM crops would offer no guarantee that these thresholds could be secured. It would be necessary to have enforceable rules, including but not limited to minimum separation distances between crops. These measures should be established through binding protocols, and this would require authority in primary legislation to establish the regulatory framework. However, the scheme should be flexible enough to ensure that the detailed measures in protocols could be varied in the light of new evidence without having to revise the law. This suggests an approach modelled on a binding code of practice.

183. Farmers growing non-GM or organic crops, particularly to lower thresholds than 0.9%, would also need to take measures to minimise adventitious presence of GM material in their crops, for example by controlling volunteer plants carefully and cleaning machinery before harvesting crops.

Recommendation 2: If GM crops were to be grown commercially, farmers growing them should be required to follow legally enforceable crop management protocols designed to achieve at least the 0.9% threshold.

184. For coexistence to be successful, breaches of thresholds would need to be rare. But there is uncertainty about what the cumulative effects of the different sources of adventitious presence might amount to in commercial production at different levels of growing GM and other compatible crops, and what threshold levels could actually be delivered in practice using crop management protocols. The possibility and extent of negative economic impacts on non-GM and organic farmers is also uncertain. We believe therefore that if GM crops were commercially grown, there should be an initial period of a few years where particular care would be taken in auditing and monitoring coexistence arrangements[178]. Precaution should continue therefore to be the basis of Government policy-making, based on all the evidence available.

185. The concern that 0.1% may be unachievable in practice if GM crop cultivation became widespread, however, is held on both sides of the debate about possible commercialisation. Consistent with this, we all agree that it will be necessary to investigate whether and to what extent the 0.9% and 0.1% thresholds are achievable in practice on the farm, and what levels of adventitious presence are being found in non-GM and organic final products. The data-gathering in the initial period should be designed to allow Government, farmers and producers in all sectors, and the public, to assess whether coexistence arrangements are meeting the goals set for them, what is realistically deliverable in commercial production, and what this means for policy on growing GM and other crops in the UK.

Recommendation 3: If GM crops are commercialised, there should be an initial introductory period where there would be intensive monitoring and auditing of coexistence arrangements to determine whether and how far coexistence was actually being achieved.

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[178] And also monitoring of environmental impacts – see Part 3.

Recommendation 4: The powers to impose coexistence protocols should allow for their ready amendment if data gathered in the introductory period showed that coexistence and the delivery of consumer choice was not being achieved and the Government should be able, if necessary, to suspend production of a GM crop unless and until arrangements were made to overcome coexistence problems.

186. In addition, some of us would strongly prefer there to be a formal limit on the rate of take-up of GM crops during an introductory period by means of a statutory annually reviewable limit on the area of GM cropping or on the amount of GM seed sold.

187. There would be difficulty in reconciling such limitations with European law, where they might be characterised as arbitrary interference with trade. Aside from being quite possibly illegal under EU law, other AEBC members believe that an artificial limit on GM take-up would be unfair to those farmers who might want access to the technology and be denied it. They argue that there has been a trial period on coexistence already, in effect, through the FSEs. Market conditions - including public attitudes to GM crops and adventitious presence from them - will naturally condition take-up rates. If take-up is higher than expected that would suggest that farmers have assessed that there is sufficient consumer and market demand and, most likely, that coexistence arrangements are working adequately to deliver consumer choice.

188. A further option, which might be more acceptable to industry and farmers who wish to grow GM crops, would be for the agricultural biotechnology industry to agree with Government a voluntary limit on sales during the introductory period. The level set for such a voluntary agreement would take account of what area of cropping would be practicable to cover with the intensive programme of monitoring and auditing in the introductory period, and market conditions. Voluntary agreement between industry and Government would not fall foul of EU law and could well be achievable.

189. Our views on where the burden of responsibility should lie for taking some of the crop management measures necessary to test coexistence arrangements in the initial period, particularly following recommended separation distances for 0.1% in addition to 0.9%, vary according to our views on the reasonableness or otherwise of GM growers working to a non-statutory threshold.

PART 2.5 OPTIONS FOR UNDERPINNING COEXISTENCE PROTOCOLS

190. If it were decided to allow the commercial production of GM crops in accordance with a system based on protocols, the operation of the protocols themselves would need not only to be effective and enforceable (in an introductory period and also thereafter, if coexistence had been shown to be practicable) but also inspire the confidence of farmers and the public. We have considered various possible approaches.

Possible approaches

Voluntary protocols

191. Some of us think that voluntary arrangements mirroring the SCIMAC scheme would be proportionate, flexible and efficient, and that the experience during the FSEs, which worked on that basis, suggests that this approach would work satisfactorily in commercial production. Even if protocols were voluntary, there are increasing commercial drivers on farmers to comply with best practice and specific standards in producing crops for supermarkets and other buyers. Protocols to comply with GM crops could be bolted on to one of these schemes.

192. But a key problem for a purely voluntary system is that there is no market driver in a voluntary system for a farmer growing GM crops to seek to protect his neighbour's crops from adventitious presence. Supermarket requirements for non-GM produce would bite on the non-GM farmer, not the GM farmer. The problem is that those farmers who fear they might suffer economic loss are not confident that voluntary protocols alone would offer them sufficient protection. These farmers and others question what incentive the GM cropping farmer or GM consent holder would have in making a system of voluntary protocols work, since it would not be they who would lose out if they failed. There is also a significant issue of getting a reasonable degree of confidence among potentially affected parties were GM crops to be commercialised. More would be needed than simply assuming farmers would follow protocols with no compulsion to do so (even though the SCIMAC guidelines which governed the FSEs worked on that basis[179]).. Given this, we are recommending legally binding protocols, but as noted elsewhere in our report, some of us are only content to do so providing putting the legal arrangements in place does not a purely voluntary scheme with no economic incentive on GM growers to comply does not seem realistic.

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[179] An independent audit of the operation of the guidelines carried out by ADAS Consulting Ltd found no instances over three years of non-conformance with the critical control points; of the initial 13 queries, 11 of which were on separation distances, all turned out to be unfounded. Conformance was less good on issues of documentation (*Audits of GMHT crops within the Farm Scale Evaluation Trial, Harvest years 2000-2002*, Summary Report, ADAS Consulting Ltd, April 2003). In a separate survey of growers carried out by SCIMAC, 75% of growers thought that the SCIMAC guidelines as they stood would be an effective basis for coexistence on their own farm, and a further 22% thought that they would with modification. The equivalent figures for coexistence with neighbouring farms were 60% and 31%, with 8% unsure.

Protocols developed and underwritten by the agricultural biotechnology industry

193. The agricultural biotechnology industry, working together with GM cropping farmers and seed suppliers, is in principle probably best-placed to facilitate the development and use of crop management protocols, building on existing knowledge and practice in the FSEs and in other schemes. There are significant attractions in giving the biotechnology industry responsibility for establishing and enforcing the protocols, so that it would be up to them to make the system work, as they believe it can.

194. Industry has the relevant knowledge and experience to design the detailed terms of protocols, though wider consultation in doing so, to help build public confidence, would be advisable. This approach could keep protocols flexible and adaptable, and avoid creating new and possibly cumbersome mechanisms to deliver coexistence. Along the supply chain, there could be mechanisms to promote compliance with protocols by farmers employing the technology.

195. By way of enforcing protocols, seed companies would be able to stipulate in contract that farmers growing GM crops used best practice. The companies have the right to decide to sell/supply seed to whom they want. In this case, they would sell only to those who have signed up to growing the crop in accordance with protocols. If a farmer failed to abide by the terms of the protocol, under the existing statutory provisions the GM consent-holder could in principle withhold future access to the GM technology from the farmer.

196. It is less clear whether there is scope in the present legislative framework for punitive sanction in the case of breach of a protocol. Under the 1997 Plant Varieties Act there is civil remedy in law for recovery of royalties due to the holder of the intellectual property rights, but further examination is needed of whether a consent-holder could require a crop to be destroyed in the case of a serious and ongoing breach of the coexistence protocol. There is, however, a question mark over the extent to which there would be sufficient economic incentive for seed merchants to administer arrangements of this sort: on behalf of consent holders.

197. But such a system, while potentially both neat and flexible, would only command the confidence of non-GM and organic farmers if there was an economic incentive for industry to make sure farmers followed protocols which delivered successful coexistence and to withdraw seed from non-compliant farmers. The incentive would be a requirement to pay compensation for economic loss resulting from adventitious presence. As there is no indication[180] that industry believes it would be appropriate for it to provide compensation to back-up such a system and so make it in their clear self-interest to make co-existence measures work, this option does not seem viable.

Protocols developed and policed by an independent body

198. Establishing an independent stakeholder body to undertake overall supervision of coexistence arrangements, with an independent chair and a diverse membership (including representatives of farmers (of all kinds), the biotechnology industry, retailers, consumers and Government) might help engender greater confidence. Although such a body could not itself have direct executive

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[180] See Part 2.6.

responsibilities, such as determining the detailed content of protocols or policing their operation, it could act as a board, ensure that all parties were consulted on important decisions, and insist that the whole operation was transparent (even when this might be uncomfortable for one or more of the parties involved). It would also have the merit of trying at the national level to engender cooperation among potentially affected parties, reinforcing or perhaps learning from cooperation among farmers at the local level.

199. It would have a particularly important role during an initial introductory period. It could blow the whistle then or later if it judged that coexistence arrangements were not working satisfactorily.

200. Some of us can see some merit given the present climate of public opinion in a broad-based independent body in relation to coexistence of GM and other crops but think that GM crops should not be singled out in this way. If it is not acceptable for this sector of agriculture to be governed by those without a direct financial interest in the outcome, then the organic and conventional farming sectors, by the same principle, should also have broad-based governance including parties without a direct financial interest in the success of that sector. Some of us believe that had this been the case for the organic sector in particular, then the discussions about achieving coexistence might well have been more straightforward. Others of us doubt that.

201. Our experience suggests, however, that an independent stakeholder body would face a near impossible task initially in getting broad agreement to the terms of the protocols, particularly separation distances, if it was asked to accommodate a 0.1% as well as a 0.9% threshold[181]. Government would need to give it clear guidance on the thresholds which protocols would be designed to deliver in advance.

The HEAR and North Essex schemes

202. We have looked at two schemes in the UK that make more formal arrangements to seek to maintain purity levels in crop production.

203. In North Essex, there is a voluntary zoning scheme to protect the purity of seed crops from which seed must be supplied at the required purity for the premium price[182]. If a farmer wishes to grow seed crops of certain species (of Allium, Beta or Brassica) which are sensitive to cross pollination he may choose to register them voluntarily under a scheme set up by statutory Order. By doing so he and his neighbours can agree siting of any possible cross-pollinating crops before they are sown. This avoids the potential need to use statutory powers under the Order to prevent an offending crop from flowering in cases where a registered seed crop is threatened by damaging cross-pollination from an unregistered crop[183]. The scheme operates on a small scale: in harvest 2002, only 7 seed crops of the above species were registered totalling an area of 43 ha. No disputes were reported to Defra.

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[181] The issue of how to deal with the question of compensation for breaches of thresholds would remain to be addressed.

[182] Since 1939, a voluntary seed zoning scheme supported by provisions contained in the Plant Varieties and Seeds Act 1964 has been in place in North Essex. It is operated by the North Essex Seed Zoning Committee, with the support of seed merchants and seed companies in the area. Its aim is to maintain North Essex as a uniquely secure area for the production of seed from certain plant species which are sensitive to cross-pollination, which it has done successfully for over 60 years.

[183] In a case of a dispute that the Committee was unable to resolve, under Schedule 7 of the Plant Varieties and Seeds Act 1964, the Secretary of State may take action to prevent the crop from flowering.

204. If a farmer grows high erucic acid oilseed rape (HEAR), maintaining separation is essential because the crop is poisonous and must not enter the food chain. There are industry protocols to ensure separation throughout, which include notifying and if necessary reaching an accommodation with neighbouring farmers. Unless the prescribed minimum separation distance of 50m is observed, both crops (i.e. the crop sown first as well as that sown last) will be considered not to be sown in accordance with local standards, which will mean that neither farmer will receive payment under the Arable Areas Payments Scheme[184]. We understand that as a result of these arrangements, no contamination of food crops has occurred in the UK or in other EU Member States, despite the relative ease with which rape can out-cross. (Some of us consider that this is a very good indicator that protocols to deliver 0.9% ought to be practicable. Others of us note that the tolerance for adventitious presence with HEAR crops is greater than the 0.9% planned for GM crops.)

205. The incentive in the North Essex Scheme is market based (with regulatory backing, although Ministerial action to remove an offending crop has never been needed, so far as we are aware); the incentive in the HEAR scheme is also market-driven – one does not get best market price if the required standard is not met – but also has regulatory underpinning in that ultimately subsidy payment can be withdrawn, although we have heard of no instance of that happening specific to HEAR. Neither scheme addresses the issue of compensation for economic loss if and when coexistence measures fail.

206. The North Essex scheme relies on registration, and embodies the concept of precedence, whereas the HEAR scheme treats both "offenders" equally. But it depends on advance notification, which could significantly limit flexibility of farmers' planting decisions if operated on a national scale for widespread cropping[185].

A Government-run scheme based on regulation of pesticides

207. We have considered possible parallels with the operation of the regime of legislative and administrative controls over the approval, storage, marketing and use of pesticide products[186]. The Pesticide Safety Directorate of Defra (PSD) is the regulatory authority with responsibility for the safety of pesticides used in crop and plant production in Great Britain. It is responsible for evaluating the data which are required to ensure that the operator, consumer and environmental risks associated with the introduction of a new active substance are acceptable, and for carrying out a risk assessment and proposing a regulatory decision for each new active substance.

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[184] The 50m separation rule is underpinned by Article 11(6) of the Arable Area Payments Regulations 1996 (as amended).

[185] Neither of these schemes addresses the issue of compensation for any economic loss resulting from failure which some of us think points to not having compensation arrangements for GM and other crops – why should GM be treated any differently to other agricultural production in this respect?

[186] In Great Britain, the storage, supply, advertisement, sale and use of pesticides are regulated by The Control of Pesticides Regulations 1986 (as amended) (COPR), The Pesticides (Maximum Levels in Crops, Food and Feedingstuffs) (England and Wales) Regulations 1999 (as amended) and The Pesticides (Maximum Levels in Crops, Food and Feedingstuffs) (Scotland) Regulations 2000, commonly referred to as the MRL Regulations. Similar legislation exists in Northern Ireland. These regulations implement Part III of The Food and Environment Protection Act 1985 (FEPA). In addition, further regulations, The Plant Protection Products Regulations 1995 (as amended) and the Plant Protection Products (Basic Conditions) Regulations 1997 (PPPR) implement in Great Britain EC Council Directive 91/414/EEC, concerning the placing of plant protection products on the market (the Authorisations Directive). Under transitional arrangements COPR and the PPPR will run in parallel.

208. Its advice is considered by the independent Advisory Committee on Pesticides (ACP), a statutory body established to advise Ministers in the UK Government and Devolved Administrations on all issues relating to the regulation of pesticides, with 14 expert members who are independent of both Government and industry. Under the Food and Environment Protection Act 1995 and the Plant Protection Products Regulations 1995 (as amended), Ministers have powers to recover the costs of running the approval and pesticide monitoring systems. These costs are met through an annual levy on UK sales turnover of approval holders and fees for applications for approval[187].

209. There are attractions in this approach, although there must be a question mark over whether, given apparent public mistrust of Government's approach to GM crops, this would command public confidence in the short term, after any decision to allow the commercial production of GM crops. It might be an option in the longer term if coexistence arrangements were seen to be delivering consumer choice satisfactorily and public attitudes to GM crops were generally more favourable than they appear to be at present.

Statutory backing

210. The new legal authority for Member States to put in place coexistence measures would allow crop management protocols and possibly also associated underpinning arrangements to be given legal force. Some of us fear that a statutory scheme would potentially be disproportionate and that, with industry guidelines on good stewardship and cooperation between farmers, coexistence could be delivered satisfactorily (at 0.9%) without creating new statutory arrangements.

211. Nonetheless, overall we can agree that in the present circumstances, giving statutory backing to the main elements of a coexistence regime, certainly the requirement to follow protocols in GM cropping and also (see Part 2.6) compensation arrangements, makes sense, although for some of us only if making the necessary legal arrangements did not cause significant further delay in GM crops being made available to farmers. It would address the particular problem of their being no financial incentive on GM growers to abide by the terms of protocols. Statutory protocols would make clear where responsibilities would lie if crop commercialisation went ahead. A statutory scheme would probably give greater confidence to the public and stakeholders.

212. Legally binding protocols would require authority in primary legislation to establish the regulatory framework. However, the scheme should be flexible enough to ensure that the detailed measures in protocols could be varied in the light of new evidence without having to revise the law. This suggests an approach modelled on a binding code of practice.

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[187] FEPA and PPPR are two different regimes covering different types/uses of pesticides. The relevant costs associated with the FEPA/COPR regulatory regime are recovered through the FEPA levy as a % of the value of FEPA/COPR approved product sales. The relevant costs associated with the PPPR regulatory regime are recovered through the PPPR levy as a percentage of PPPR approved product sales. The costs of the monitoring schemes are recovered through both levies in proportion to the relative value of their respective turnover.

Other factors associated with coexistence

Inspection and enforcement of protocols

213. In an initial introductory period, the quality and extent of the intensive monitoring and auditing of coexistence arrangements would be critical. There is a question of how to undertake such monitoring in an initial period; and looking ahead, were GM crops to be grown commercially in the longer-term, what would be an appropriate mechanism for inspection and enforcement.

214. Looking at the longer-term, the extent and nature of inspection and enforcement in a protocol-based system would depend on the nature of any coexistence arrangements (should coexistence have been found to be practicable at the commercial scale). For example, on the possible option of the agricultural biotechnology industry setting the terms of protocols and providing compensation when they fail, it could in the first instance be up to industry to monitor how the protocols are working. It would be in their interest to do so in order to adjust protocols to be as light a touch as possible consistent with achieving reliable coexistence. The inspection and enforcement regime would have a heavier burden to carry on models which would not be economically self-reinforcing in this way. Farmers with a financial interest in minimising adventitious presence in their crops would have a strong self-interest in reporting breaches of protocols by a neighbouring farmer growing GM crops.

215. There would be a number of options for auditing compliance with protocols in the short and longer-term.

216. One option would be to give this role, particularly in the short term, to the *GM inspectorate*, which has statutory responsibility for enforcing the regulations governing the release and use of GMOs. The inspectorate would however have to demonstrate sufficiently resourced capability to undertake the necessary intensive monitoring and auditing in an introductory period. If the commercial production of GM crops were to be permitted and became reasonably widespread, looking to the longer term there would be a good case for putting monitoring arrangements in place that were part of existing monitoring arrangements for UK agriculture overall, so as not to increase unnecessarily the burden of inspection on farmers, and to take advantage of existing mechanisms. There is a further concern for some of us, however, that inspection charges could prove a barrier to entry of the technology, depending on the cost recovery regime.

217. We have considered whether it might be possible to tie coexistence protocols in to the *new arrangements under the Common Agricultural Policy (CAP)*. Following the CAP mid-term review, instead of crop linked payments there will in future be a single "decoupled" payment per farm based on historical payments and on compliance with specific statutory standards ("cross-compliance"), which would be attached to the entire area of the farm. This approach is designed among other things to integrate environmental targets with other aspects of agriculture. The responsibility for enforcing it would rest with Member States.

218. If this regime were introduced, there would no longer be specific payments under IACS (the Integrated Administration and Control Scheme) that could be

withheld if farmers failed to comply with protocols[188]. But if a farmer failed to adhere to cross-compliance requirements, which will be policed by individual Member States through random inspections and other means, then some or all direct payments to the farmer could be withheld. We do not know whether it would be possible for the UK to impose unilateral conditions with which farmers could be obliged to comply. What is clear is that the list of requirements set down at EU level could be added to in future. There seems no reason in principle to suppose that this could not include coexistence requirements.

219. There would be attractions in the option of using *existing farm assurance and stewardship schemes*, which are based on the sort of explicit acceptance of responsibility by producers that we would all hope to see for GM crops. Their use would be consistent with the NFU policy position on liability relating to GM crops[189], which says that each business should be responsible for ensuring to the best of its ability that its product meets the market standard, and that the supply chain as a whole has a responsibility to ensure market standards are practicable, workable and deliverable. We understand that a number of companies already have their own stewardship schemes for novel crops[190], and that other industries also have an embedded concept of corporate social responsibility to a wide group of people[191]. We therefore looked at some of the existing arrangements.

220. Many farmers currently use Farm and Food Assurance schemes, and their use is expanding. These schemes are voluntary systems for ensuring compliance with specific production standards. Examples are the Assured Combinable Crops Scheme (ACCS)[192] and the Assured Produce Scheme (APS)[193]. Both these schemes were formed by an industry-wide initiative, and have management boards including producers, processors and supermarket representatives. They aim to provide the traceability and assurance required for customers, through independent inspections and certification.

221. These and other schemes are members of an umbrella organisation, Assured Food Standards (AFS)[194], which was established in 2000, using the "little red tractor" as its logo[195]. The scheme is currently owned by sections of the agri-food industry (including several of the farm assurance schemes, the National Farmers' Union and the Meat and Livestock Commission). An independent chairman and a board including directors from the retail and food processing sectors, and others representing academics, consumers and environmental interests run it. Costs are

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[188] As has been the case in the past, for example in relation to high erucic acid oilseed rape: see above.

[189] National Farmers' Union Policy Position, Liability Relating to GM crops, January 2003,

[190] Minutes of 16th AEBC Commission meeting 27th Feb 2003 paragraph 26

[191] For example see reports of a conference on corporate social responsibility on 6 February 2003, including ENDS report 337, pages 4-5, report of speech by the Secretary of State for the Environment Food and Rural Affairs.

[192] Covering crops harvested with a combine harvester (see www.assuredcrops.co.uk). Since the scheme was set-up, over 12,000 registrations have been received and verified in England, covering over 2 million hectares. Adding to this Scotland's 0.2 million hectares (0.6 million acres) of assured grain means that approximately 75% of marketable combinable crops are produced by assured farms.

[193] Covering "produce" i.e. fruit, salads and vegetables (see http://www.assuredproduce.co.uk).

[194] http://www.littleredtractor.org.uk

[195] It should be noted that, despite frequent references to "British" farmers on the AFS website, the logo is not restricted to British products (which would be illegal under European competition rules); rather, it is restricted to products which comply with specific production standards included in a Food Assurance Scheme which has been registered with AFS. See http://www.foodstandards.gov.uk/foodlabelling/claimsonlabels.

covered by contributions from the various participating schemes, with initial grant support from the Government. One of its declared priorities is to encourage integration of inspections between different schemes.

222. All assurance schemes under AFS must be accredited to the new EU Standard EN45011. This standard insists on independent inspectors, annual farm inspections and a uniform inspection standard across the EU. These inspectors already visit farms once a year, and should be able to be trained to inspect whether a farmer is complying with the protocol on coexistence (for an additional cost, payable only by farmers growing GM crops). Since there is already an accredited and audited inspection service in existence, it would in principle be sensible to use it rather than setting up a new system.

223. Following the Curry Report[196], AFS was asked to review its structure to make it more publicly accountable. A consultation was carried out in autumn 2002, and in July 2003 AFS II was launched. The new organisation represents an evolution from the present federal structure of multiple schemes and standards to a unified organisation, which will administer and develop single, national core standards. A broader, more inclusive approach to the governance of AFS will be introduced that reflects the interests of the main stakeholders in the food chain. Governance will be exercised through an Ownership Body, a Board, Sector Boards, a Standards Committee and a Stakeholder Forum. A small management team will service these to manage the development and maintenance of the standards, arrange contracts for certification, and control the use and marketing of the Red Tractor logo.

224. There has been a question mark over how much these schemes are truly responsive to consumer interests and concerns, which are of course diverse and in some cases mutually incompatible. They seem to be becoming more so, and if that trend continues they might become vehicles for monitoring compliance with coexistence requirements that would command consumer and stakeholder confidence, but they might require augmentation if levels of consumer concern about GM crops remained high. We would emphasise again that in an introductory period of commercial GM cropping more intensive monitoring and auditing would be required to establish the practicability or otherwise of coexistence than standard assurance schemes are at present set up to offer. There are divergent views on the Commission, but the weight of opinion is that augmentation of the standard schemes would need to be significant in an introductory period.

225. Whatever option is chosen for monitoring and auditing, Government should, as envisaged in the European Commission's coexistence guidelines, ensure it is coordinated with the auditing and monitoring activities of European partners.

226. There is also the question of funding of monitoring and auditing arrangements. The principal options for this include charging GM farmers for the cost of audits, seeking contributions for the agricultural biotechnology industry or other parts of industry or a levy on some or all combinable crops. Government may wish to fund independent monitoring, including testing, of gene flow or at least the costs of collation of testing undertaken by individual farmers or producers (where available). Funding of monitoring and auditing costs would need to be considered alongside the

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[196] Farming & Food – A sustainable future, Report of the Policy Commission on the future of farming and food, January 2002, http://www.cabinet-office.gov.uk/farming

options for funding compensation for any economic loss arising from the breach of an adventitious presence, which we discuss in part 2.6.

A register of the use of land

227. At our liability stakeholder meeting, it was suggested that a record of land use might play a useful role, either to enable farmers to share information ahead of planting, or as a historical record, or both. Both are relevant in providing information for farmers trying to control possible adventitious presence[197]. The Royal Institution of Chartered Surveyors recently argued in a report that for an electronic land register of GM crops should be created by Government for both purposes[198].

228. For the purposes of coexistence, advance information about planting intentions, rather than a historical record, would be likely to be more important generally, although historical information may help farmers assess the likelihood of GM volunteers. Farmers usually rely at present on talking to their neighbours where necessary about cropping intentions, which is probably a more practical approach. A historic register would not be much help to the detailed coexistence discussions which would need to be held face to face in the short time between farmers' decisions being made as to which crops would be grown where and the actual planting date. If there was to be a central system, it would have to be unbureaucratic and not require filing of intentions weeks in advance of planting if it was not to unduly constrain farmers' planting decisions, which can often be relatively last-minute (a point we noted in connection with the North Essex scheme[199]).

229. Were GM cropping to become widespread, there might eventually need to be national or regional coordination of exchange of information, or at least agreements akin to those present in seed production. It might be possible to develop the use of GPS[200] for farmers to calculate distances to neighbouring crops. What is certain is that some form of local farmer-to-farmer prior crop notification is needed to operate separation distances. The SCIMAC guidelines require the GM grower to notify his neighbours if their land falls within the specified separation distances.

230. A new initiative is currently being piloted for six months in Hampshire, the Sussex Downs and the North York National Parks. The Land Information Management System (LaMIS)[201] aims to provide an online information system for farmers, land managers, their agents and advisers and allows easy access to public information about land, both nationally and locally. One of its main aims is to support informed decision-making and ease the process of applying for funding by highlighting opportunities and giving visibility to management plans. It has been devised for a number of reasons, including agri-environment reviews, assisting in biodiversity action plans and to support rural businesses. It has been funded by Defra, the Countryside Agency, South East England Development Agency (SEEDA), English National Parks Authority and local government.

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[197] The latter especially in relation to volunteers and to the field seed bank.

[198] *Setting up a genetically modified organism land register*, RICS Policy Unit, October 2003.

[199] The RICS report recommends 3 months' advance notice. This is based against the present background of public desire for consumer choice and for organic and non-GM farmers to make sure they can deliver this – and so needing to be sure when buying or renting land or making planting decisions that they are sufficiently far away from GM cropping. The trade-off is on planting decision flexibility for GM growers.

[200] Global Positioning System technology.

[201] For further information see: http://www.lamis.gov.uk.

231. The pilot project uses aerial photography, Ordnance Survey mapping and a "what's in this field" analysis, providing those using the service with access to detailed information on biodiversity, possible historical interests, public access rights and other key facts.

232. The system could possibly be developed to provide a planning tool to check that GM, conventional and organic crops would follow agreed separation distances. It would be possible to use on-line drawing and measuring tools to determine distances between neighbouring fields for example and even identify farm types such as GM users or organic growers, all of which could provide a basis for dialogue and cooperation planning between farmers.

233. Such a system could therefore provide significant benefits to the agricultural community but it might be difficult for some small-scale farmers to use easily and maintaining a full cropping database could be costly if the input of annual cropping data and other vital information needed to be centrally controlled. This would need further work but it seems to us that the system offers significant potential beyond possible GM crop commercialisation. We understand that a similar scheme is being developed in New Zealand for seed crop separation, which might be extended to cover GM crops there.

234. As far as past use of land is concerned:

- The Land Register does not record what sort of crop is grown on land; if it did, that might affect land values (some believe that land on which GM crops had been grown would fetch a lower price – in which case it would be serving the purpose of facilitating the operation of the market). We have not heard any evidence of change in value of land from UK farmers arising from the cultivation of GM crops, and understand that several fields used to grow GM crops have since been sold in the UK without any suggestion that the land value was affected[202].
- There is currently a register of fields planted with crops eligible for CAP subsidy payments, and the Rural Payments Agency (which administers IACS) is developing a Rural Land Register (RLR) to provide a key corporate data set, which might be in place by the beginning of 2004. In response to the Foot and Mouth Inquiries, Defra said that there might be scope to extend the RLR to encompass all agricultural parcels, not just those that were IACS registered. Detailed plans on what other data should be captured have still to be developed, and there are a number of issues concerning the confidentiality of IACS information. But with the decoupling of subsidy from production, the IACS data collection system would be expected to come to an end.
- The Scottish Executive has a database that covers 90% of cropping in Scotland. It mainly covers crops eligible for CAP subsidy payments, but does include some information beyond this. As it is set up at the moment it would not record where GM crops were grown, but this would not be technically difficult to change. There are however significant data protection issues with the database and the

[202] Some AEBC members point to the fact that it is already standard agricultural practice to make cropping histories known to potential purchasers, so to that extent GM cropping would not raise a new issue. Although detailing crop history is not a formal requirement in agricultural land sales, if a potential buyer desired the information, it is likely that the seller would seek to provide it (along with data about yields, soil type, etc.)

information can currently be used only for processing payments. Again, how the system will develop or not depends on the next steps following CAP reform.

235. We endorse efforts being made to explore ways of making reliable information about crop locations available to growers who need it for coexistence purposes, although some of us consider open publication of precise locations of GM crops to play into the hands of protestors who have pledged to take action to physically destroy GM crops[203] and argue strongly that in these circumstances some restrictions on publication of 6-figure grid references are necessary. A central record would work as a historical record but to require this for intended planting would place significant constraints on farmers' decisions about what crops they plant where on their farm. Local farmer-to-farmer prior crop notification system would be needed in order to operate separation distances effectively; and if this mechanism works effectively, it would seem to give maximum flexibility in respect of last-minute planting decisions.

236. We would encourage Defra and others to consider development of LaMIS and/or comparable systems as tools to help facilitate farmers' decision-making on possible coexistence issues as well as other land-management decision on the farm.

Where would the costs of making coexistence work fall?

237. Aside from the issue of compensation for economic loss from threshold breaches arising out of adventitious presence (Part 2.6 below), there is the issue of costs of making coexistence protocols work.

238. In terms of who should be responsible for ensuring coexistence at an agreed threshold, most of us believe that the onus should fall primarily on the farmer growing the GM crop to follow crop management protocols, although cooperation between farmers would be in the interests of all. But as discussed earlier, not all of us who take that view agree that this should include an onus on meeting an organic threshold of 0.1%. If adventitious presence could be maintained below the relevant thresholds with no change in present farming practices, the decisions of individual farmers would have a limited impact on others. But if achieving coexistence through protocols would involve changing farming practices, this could impose costs. Our initial view is that for farmers growing GM crops these should not be significant, if protocols were based on existing good practice as set out earlier in table B for the FSE crops.

239. The exception might be the opportunity costs on a GM farmer of observing separation distances (which should not be onerous if the distances are not too large); and the cost of audits of compliance with protocols (which would be reduced if they could be combined with other audits which would have been required in any case[204]); and possibly non-GM farmers and GM-cropping farmers not being able to share farm machinery. To set against any costs to GM farmers, there could be benefits from higher yields, reduced use of herbicides and pesticides, and reduced energy use[205].

240. Non-GM and especially organic farmers rather than GM farmers are likely to be the party with the greater need to test their crops and consequently meet the costs of

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[203] See the 'green gloves' campaign literature (www.greengloves.org)

[204] At present, BSPB at present audits seed merchants (on the basis of intellectual property rights); the price of conventional seed includes the cost of audit.

[205] Brooms Barn conclusions, see http://www.rothamsted.bbsrc.ac.uk/broom/gm_work.html

testing (although in the future GM farmers might have to pay for testing to show that a high-value GM crop was of sufficiently high purity)[206]. However, it may well be that farmers interested in growing GM crops would choose to produce some GM and some (compatible) non-GM crops on the same farm so testing requirements would not always be caused by another farmer's use of GM. A useful goal of public or commercial research to help farmers support consumer choice could be to develop more convenient dipstick tests to test for GM reliably on the farm. In the absence of particular measures, that ultimately this is a matter for the market, which may be expected to determine whether the costs would fall on the consumer, on the farmer, somewhere in distribution chain or on the consent holder.

[206] See Annex B for information on the costs of testing.

PART 2.6 COMPENSATION FOR ECONOMIC LOSS

241. We have sought options that would minimise disputes and claims among farmers, and facilitate dealing with any which did occur[207]. We have looked at the possible adoption of protocols to minimise breaches of adventitious presence thresholds. If protocols were to successfully deliver coexistence then they consequently would minimise disputes and claims.

242. We noted in Part 2.5 that there are a number of different options for arrangements to underpin crop management protocols, and that the most promising models would seem to be either having a representative group of stakeholders oversee the agricultural biotechnology and farming industries' implementation of the practical arrangements, or a Government-led scheme. We concluded that the arrangements underpinning crop management protocols must command the confidence of the public and the farmers who might be affected and so should be given statutory backing.

243. We also concluded that intensive auditing and monitoring of whether coexistence protocols were working and being followed would be essential in an initial introductory period of GM crop cultivation. Auditing and monitoring would remain important aspect of coexistence arrangements in the longer-term, were the introductory period to indicate that coexistence was practicable. Development of systems to give farmers access to landscape and cropping intentions to manage any coexistence regime, preferably alongside other land management decision-making, should be given further attention.

244. But even if there were a workable coexistence system, there would inevitably be at least occasional cases where the system failed, so we have looked at options for dealing with this. We considered both what could happen during an initial introductory period; and in the scenario where GM crops were being grown commercially after an initial introductory period.

Possible economic loss

245. The commercial production of GM crops might in principle cause damage to other individuals, or to society as a whole, of three main kinds:

- damage to the ability of consumers to choose between GM and other agricultural produce.
- damage to the economic interests of another party, arising from adventitious presence of GM constructs – considered in this Part of the report.
- in a different category from the two above is the possibility, however remote (we have divergent views on how remote), of damage to the environment or to human health. This may arise as a result of what was assumed, when granting Part C approval, to be a slight risk but in fact materialised, or else be of a kind or

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[207] A Liability for Release of Genetically Modified Organisms (Scotland) Bill, backed by Green MSPs has recently been proposed for introduction to the Scottish Parliament and is now the subject of consultation by Mark Russell MSP (*GM liability – who should carry the can?*, November 2003). The proposed legislation would make agricultural biotechnology companies liable for any economic loss Arising from adventitious presence.

to a degree that was not foreseen or even foreseeable at the time of the risk assessment. Environmental impacts are considered in Part 3 of the report.

From the opposite perspective, there are opportunity costs for farmers who want to grow GM crops but are prevented from doing so either because the crops are unavailable or, possibly, because of coexistence protocols.

246. It is important to note that the main aim of any coexistence arrangements needs to be understood to be seeking to deliver consumer choice and the discussion of compensation must be seen against that aim. Compensation to farmers or other parties could in principle be available to the satisfaction of all farmers economically disadvantaged by failure of coexistence arrangements, but that would have no necessary connection with maintaining or promoting consumer choice. If the crops cannot be kept satisfactorily separate, then there would be a reduction in consumer choice, regardless of whether any farmer is compensated. Nonetheless, the issue of who would or should pay if coexistence arrangements did not work satisfactorily, in the short or longer term, is an important issue for many farmers and stakeholders.

How economic loss might arise

247. We distinguished a number of situations in which the commercial growing of GM crops could give rise to direct or indirect economic loss as a result of the actual or feared adventitious presence of GM material in a non-GM or organic crop[208]. This could happen, for example, if:

(a) a particular crop was found to have a GM content above the relevant threshold, so a non-GM farmer lost a price premium on that crop or was unable to sell it.

(b) a particular crop was found to have a GM content above the relevant threshold, so an organic supplier lost organic certification and accreditation[209].

(c) a crop was grown near a GM crop, or a supplier was located near a farm where GM crops were grown, so (even though adventitious presence was not detected or was below the required thresholds) a potential purchaser decided not to buy that crop, or more generally not to buy from that supplier, or to pay a reduced price[210].

(d) a farmer made a precautionary planting decision not to grow a particular crop, to avoid the possibility of its being unacceptable because of its proximity to GM crops[211], and thereby suffered an economic loss.

Expected frequency of losses

248. Given that there has been no commercial experience of growing GM crops in the UK, there is uncertainty about the expected frequency of losses. Evidence from overseas is limited[212], and may relate to different patterns of agriculture, market conditions and labelling requirements to the United Kingdom.

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[208] Further detail on examples of potential economic impacts were described in the liability group's scenarios of September 2002, which can be found on the AEBC website (http://www.aebc.gov.uk).
[209] For example, see response to liability scenarios consultation by Soil Association and D Williams.
[210] For an example of this, see Scenario 9.
[211] For example, see response to scenarios consultation by A Turner.
[212] PG Economics study, p. 38

249. In 2001, the Organic Farming Research Foundation's survey of US organic farmers[213] found that 8% had suffered direct financial loss from GMOs. The Soil Association reported that two grain elevators in North America specialising in organic oilseed rape were rejecting 2 and 5% respectively of incoming loads; and cited other instances of organic and non-GM farmers facing significant problems and economic loss from adventitious presence in Canada and the US from the growing of GM oilseed rape and maize[214]. Other parties dispute either or all of the significance, scale and causes of these reported findings.

250. The Spanish agricultural biotechnology association[215] recently reported that there has been successful coexistence of organic and conventional maize in Spain, the only EU country where GM crops are being grown on a commercial scale[216]. This is the conclusion of a recent study by PG Economics[217]. Spanish farmers growing GM maize are producing it for animal feed, which has not had to be labelled hitherto. It is understood that there are price premiums available in Spain of about 15% for non-GM maize for the snack food sector, with growers meeting specific contracts to deliver GM free produce. These premiums may prompt non-GM growers to take greater care in segregating their non-GM crops to reduce the instances of adventitious presence in their own crops. The Spanish Association of Corn Growers reports that some 5% of batches of maize destined for one of Spain's largest food processors were rejected due to adventitious presence of GM. There were two cases in 2001 of adventitious presence in organic maize crops, but none since then (a small amount, estimated at between 100-1000 hectares, of organic maize is grown annually in Spain, out of total maize plantings in Spain of around 460,000 hectares)[218].

251. There is no unambiguous evidence on which to draw from abroad and in any case it obviously cannot pertain exactly to future UK markets or farming situations. There is therefore considerable uncertainty about what lessons if any may reasonably be drawn about the probable frequency of economic loss from adventitious presence in the UK from the limited (and in some cases disputed) evidence from commercial production overseas.

Potential losses from adventitious presence

252. We take the view that that compensation should be available to farmers or other parties who suffer economic loss from breaches of the statutory adventitious presence threshold. Some of us believe in addition that compensation equally should be available for economic loss arising from breaches of the 0.1% threshold.

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[213] 4th National Organic Farmers' Survey: Sustaining Organic Farms in a Changing Organic Marketplace, Organic Farming Research Foundation, May 2003. (www.ofrf.org)

[214] For example, the virtual cessation of organic oilseed rape production in the Canadian province of Saskatchewan. *Seeds of Doubt*, Soil Association, September 2002.

[215] ENDS Environment Daily, Issue 1517, 25 September 2003, referring to http://www.fundacion-antama.org ENDS reports that the Spanish Government food research institute (Irta) is expected to publish soon results of cross-pollination between GM and other crops.

[216] Around 32,000 hectares of GM maize were grown there in 2003.

[217] *Co-existence of GM and non GM crops: case study of maize grown in Spain*, G Brookes & P Barfoot, PG Economics Ltd, October 2003.

[218] From 'GM grain gain in Spain', Charles Abel, Farmers Weekly, October 10-16, 2003; and the PG Economics study.

253. To give some idea of the magnitude of potential economic losses from adventitious presence, we have considered the worst case – how much an organic farmer might lose as a result of adventitious presence of GM material above the acceptable limit[219].

Potential loss on an individual crop

254. The amount that a farmer stands to lose because an individual crop fails to meet the organic standard ("the organic price premium"[220]) depends on market conditions at the time, so figures quoted can only provide an approximate snapshot. They have been calculated on the assumption that a crop that did not qualify as organic could be sold as a conventional non-GM crop[221].

- For *sugar beet*, in 2002 British Sugar (the monopoly buyer in the UK) was offering an organic price premium of £14 per tonne[222]. On the basis of yield of around 33 tonnes/ha (though note that yields vary), loss of the organic price premium would result in a loss of £460/ha[223].
- Most organic *forage maize* is either used on the farm or sold locally. If a crop fails to meet the standard, an organic farmer who intended to use it as fodder for his own animals would suffer a double loss: he would lose what he has spent on producing the crop (estimated at around £360/ha), and he would have to buy fodder for his animals (likely to cost at least the equivalent of £360/ha, assuming that supplies are available). Against this loss can be set any proceeds from selling the crop at the conventional price (say, £200/ha). The loss to an organic farmer could thus amount to over £500/ha.
- For *grain maize*, there is a price premium of £20-£30 per tonne for conventional non-GM grain over GM grain. Assuming that the organic price premium (for sweetcorn) might be as much again, on the basis of yield of around 5.75 tonnes

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[219] Drawing on the (rather sparse) information available from John Nix, *Farm Management Handbook, 33rd edition (2003)* (September 2002); Nic Lampkin, Mark Measures and Susanne Padel, *2002/03 Organic Farm Management Handbook* (University of Wales, Aberystwyth, 2002); PG Economics Ltd, *Consultancy support for the analysis of the impact of GM crops on UK farm profitability*' (prepared for the Prime Minister's Strategy Unit, April 2003).

[220] Differences in production costs per tonne are not relevant for this exercise, so the figures are *not* of margins (which would also depend on relative costs or production and relative yields).

[221] That is, with adventitious presence greater than 0.1% but not greater than 0.9%. If the higher threshold was breached then the organic farmer's loss would be increased by any difference between the price for a non-GM crop and one containing greater than 0.9% GM material.

[222] It was paying £45 per tonne for organic beet, as compared with £31 per tonne for conventional beet. British Sugar also waived transport costs for organic products. Given that British Sugar is the monopoly buyer, it would be in position to blend any crop with a GM adventitious presence with other crops with no or almost no adventitious presence, to reduce adventitious presence to a very low level. This might affect the level of economic penalty British Sugar imposed on a farmer who had breached a 0.1% threshold. We do not know if it would or not; this is one more aspect example of the uncertainty around the nature of the economic impacts of growing GM crops. And it may in time be considered relevant that the harvested product in beet production for sugar, i.e. the tuber, would (for GM herbicide tolerant crops) contain no GM events other than any leaf residue, even before processing. The same would be true for potatoes.

[223] However, for cross-pollination to occur between a GM beet crop and an organic beet crop both the GM farmer and the organic farmer would have to permit bolters or weed beet to reach maturity and flower, which is contrary to good agricultural practice in both cases. Moreover, it is the root that is harvested, and contamination would only be detectable that year if the bolters were allowed to set seed and the seed harvested, again an unlikely situation. GM weed beet could however be present in future years in the field, although it would have to be allowed to persist through the rotation to contribute to adventitious presence in a future organic (or non-GM) beet crop.

per hectare, loss of the organic price premium would thus result in a loss of some £150/ha.

- For *oilseed rape*, not even a rough estimate is available because at present it is such a minor organic crop in the UK.

Potential loss for a non-GM farmer

255. As noted by the PMSU, "the nature of the rules for growing GM crops will determine how effectively they can be kept separate from non-GM crops at the farm level, and to what extent non-GM and organic farmers may have to incur costs themselves in ensuring the integrity of their products. Whether they could pass on any such costs would depend on the relative demand for their goods, which would be higher in scenarios where the public has negative views about GM produce.[224]"

256. If non-GM farmers were working to market-driven thresholds lower than 0.9%, then they too could face loss of a market premium, although not an organic premium. The latter premium would be expected to be usually greater, so losses for non-GM farmers would be less per hectare; but on the other hand could obviously be much greater in frequency, in that there are many more conventional than organic farmers and the cropping areas of relevant crops are much bigger. But this is uncertain.

Potential loss from removal of organic certification of a field or farm

257. At present, land on which a GM crop has been grown cannot be used for organic crops for the next five years. It is not clear at present what action an organic certifying body would – or could – take if adventitious presence above 0.1% were found in a crop from a particular field, or if a GM volunteer or a weed which had crossed with a GM plant was found in an arable field. We understand that legal advice is being taken on these questions. But if a similar rule were to be applied, the loss to the farmer might amount to five times the organic premium mentioned above (assuming that the farmer continued to manage the field organically thus obtaining lower yields, albeit on different crops in rotation).

258. If instead of decertifying a specific field[225], the certifying body were to decertify a whole farm, the loss would obviously be much greater. It would include the total organic price premium loss for all crops in the relevant year or years, together with any premiums for organic livestock on the farm, as well as the sunk costs of conversion to organic and future costs of reconversion. This clearly could be cumulatively expensive for the farmer, to say nothing of the inconvenience and dismay involved. Losses would depend on how severe were the sanctions that organic certification bodies chose to implement in circumstances of discovering adventitious presence of GM material.

259. It remains to be seen whether in practice decertification would occur in these circumstances.

Potential loss to a GM grower or would-be grower

260. We noted that similar issues could in principle also arise in reverse. If a GM crop attracted a premium price because it had particular qualities, a GM grower

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[224] PMSU report paragraph 4.4.6, p.102

[225] As the UK Compendium of Organic Standards suggests is possible: Part 2, Annexes, 15.5.

could suffer loss if adventitious non-GM presence were detected in his crop, and as a result the price was reduced or the market lost.

261. Similarly, a would-be GM farmer might not be allowed to grow GM crops if he were too near an organic farm, or might decide not to grow them because of the practical constraints imposed or the attitudes of his or her neighbours, thereby suffering an economic loss[226]. Depending on other economic pressures on farmers, and prevailing market conditions, that lost opportunity could be significant, as might possible losses for non-GM and organic farmers from adventitious presence.

262. Some of us wish to reiterate that there must be symmetry in considering coexistence issues, and that it is essential that policy on GM crops, in seeking to meet the objectives of GM and non-GM farmers, does not make it impossible for farmers who want to grow GM crops to do so. Considering that 98% of UK farmers are not organic farmers and thus potential GM producers, this is a question of fundamental importance to the farming industry.

263. Opportunity costs for potential GM growers, as with the cases (c) and (d) above of indirect loss from the possibility of adventitious presence, would seem likely to be considered as insufficiently direct and/or too difficult to verify or quantify to attract compensation in any compensation scheme.

What would happen in law at present?

264. Our starting point was to consider how far existing laws would cover situations like these, and then to ask whether they were adequate, or whether they would require further development.[227]

265. So, first of all, if GM crops were grown, what conditions apply and what factors would the courts take into consideration if a farmer sued for compensation because his or her crop had decreased in value as a result of adventitious presence?

Conditions which apply

The claimant needs to have a protectable right recognisable in law …

266. In order to bring a civil case for compensation, the claimant must have a protectable right in law. For compensation for the kind of loss with which we are concerned here, the claimant would be likely to bring forward a case on the basis of the tort[228] of nuisance[229] or a negligence case.

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[226] "In the short term, however, negative consumer attitudes can be expected to limit the demand for products containing GM foods, and therefore the economic value of the current generation of GM crops…any net cost and/or convenience savings associated with the current generation of GM crops would be likely to be outweighed by the lack of a market, limiting their economic value. Interest from farmers may be limited to goods destined for export markets, for the production of animal feed." PMSU, p102. In addition to animal feed for export, non-food crops for export or home use could also be of interest to farmers in the short-term.

[227] We were greatly helped in this by Richard Burnett-Hall's review of the existing law on liability for damage caused by GMOs, which is at Annex D, and which is liberally referred to in this part of the report.

[228] A tort is a civil wrong or injury arising out of an act or failure to act, independent of any contract, for which an action for damages may be brought.

[229] Strictly, 'private' nuisance (rather than 'public' nuisance).

... in nuisance

267. Damages in nuisance would be available *only to a landowner*[230]. The legal system has long experience of moderating relationships between owners and occupiers of adjoining land, and the law of nuisance has developed a pragmatic approach towards conflicting land uses. To obtain damages, a landowner would need to establish that the defendant's use of his land was "unreasonable" in relation to his own land, and that this had caused, or would cause, foreseeable damage to him. He would not need to prove any fault on the part of the defendant. Non-GM farmers and those growing GM crops in line with consent conditions would both have wholly legitimate but potentially competing interests.

268. But in deciding whether or not the defendant's use of the land was reasonable, the court would be likely to take into account whether the claimant's use of his land was particularly sensitive. It might find that if what the defendant was doing would not interfere with a "normal" use of the claimant's land[231] he had no ground for complaint. In deciding what is "normal", the court would be likely to take into account what was regarded as acceptable by regulatory authorities. There could be an issue over whether organic farming is a particularly sensitive use of land in respect of the 'zero' or 0.1% threshold for adventitious presence, particularly given the present position as set out in the European Commission's guidelines to Member States on coexistence that in the absence of any separate threshold for organic crops, 0.9% should apply to them too. But organic farming – as a legally established and Government supported activity - would seem unlikely in itself to be considered a sensitive use.[232]

... in negligence

269. Damages in negligence would be available *to a person to whom a duty of care is owed*. "There is no such thing as negligence in the abstract; negligence is simply neglect of some care which we are bound by law to exercise towards somebody"[233]. It is for the claimant to establish that a duty of care was owed to *him*. In determining this, the court will consider whether the damage is reasonably foreseeable, whether there is a relationship of proximity (which may be physical, circumstantial, causal or assumed[234]) between the parties, and whether the imposition of a duty would be fair, just and reasonable[235].

270. Damages are *not available*[236] *for economic loss alone*[237]. They are available only for loss resulting from interference with rights to use of land, or harm to people

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[230] Using the term broadly to cover anyone with a proprietorial interest in land e.g. as a lessee.

[231] *Robinson v. Kilvert*, (1889) 41 Ch. D. 88. See also the comment of Buxton LJ. in *R. v. Secretary of State for the Environment, Transport and the Regions, ex p. Watson; Sharpes International Seeds Ltd.*, [1999] Env. L.R. 310.

[232] See minutes of 15 November 2003 AEBC liability group evidence taking meeting, paragraph 8

[233] *Thomas v. Quartermaine*, (1887) 18 Q.B.D. 685 at 694. Who that "somebody" is was the subject of the well known statement by Lord Atkin in *Donoghue v. Stevenson:* "You must take reasonable care to avoid acts and omissions which you can reasonably foresee would be likely to injure your neighbour. Who, then, in law is my neighbour? The answer seems to be – persons who are so closely and directly affected by my act that I ought reasonably to have them in contemplation as being so affected when I am directing my mind to the acts or omissions which are called in question" [1932] A.C. 562 at 580.

[234] *Sutherland Shire Council v. Heyman*, (1985) 60 A.L.R. 1 at 55-56.

[235] *Caparo Industries plc v. Dickman*, [1990] 2 A.C. 605 at 617-618. See also *Anns v. Merton London Borough Council*, [1978] A.C. 728 at 751-752.

[236] Except in special circumstances of no immediate relevance.

or property. What amounts to harm may be contentious. Nearly all legal systems impose limits on intangible loss, and do not cover pure economic loss claims unless the claimant had suffered direct physical damage (with exceptions for example for negligent misstatements)[238]. It is not clear whether adventitious presence would be held to amount to damage to a crop. Where a case is based on physical damage, case law still follows a Victorian judgement defining very narrowly the range of damage, holding damage to be "such as can be shown by a plain witness to a plain common juryman"[239]. Adventitious presence would not be visible in this way. If harm can be established, however, a defendant is liable for financial losses flowing from it that are not too remote.

271. Moreover, a recent Court of Appeal judgement[240] suggests that a liability regime is unlikely to offer redress unless there is *direct loss*. The statutory regime for liability for marine oil pollution[241] defines damage as including loss, and does not distinguish between physical and economic loss. However, the Court held that indirect economic losses from oil pollution were not recoverable under the statutory compensation scheme that applies for the oil industry. It argued that damage had to be given some limits, and that if Parliament had intended any wider scope it could have been expected to make that explicit. This implies that redress would not be available where a loss resulted from market or precautionary decisions[242]; it might thus have implications even for farmers or beekeepers that suffered economic loss related to GM crops.

The defendant had caused the harm

272. The claimant would have to prove to the court (on the balance of probabilities) that a *specific neighbouring farmer* caused the damage, which would involve proving that there was a clear cause and a direct link to one or more identifiable offending GM crops. In practice that could be very difficult[243], for example if a farmer had several neighbours growing GM crops or if there was the possibility of the source being adventitious presence from his seed or machinery.

The harm was reasonably foreseeable, and (unless strict liability applies) the defendant could have prevented the harm by taking reasonable care

273. Generally, a defendant in nuisance is not liable for damage that was not foreseeable at the time of his acts or omissions.

274. But once such harm is a foreseeable consequence of those acts or omissions, strict liability applies: that is to say, the defendant becomes liable, even if all proper and reasonable precautions have been taken to avoid such harm. Strict liability is particular likely to apply where one party is undertaking activities that entail a greater risk of harm to others than usual, when it may be considered right that he should accept all the consequences if the harm in fact materialises, however hard he has

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[237] *Victoria Park Racing v Taylor* (1937) 58 CLR 457.

[238] Information from participant in evidence-gathering meeting with lawyers.

[239] Salvin v Brancepeth Coal Co, Sir William James, (1874) 9 Ch App 705,709.

[240] *R J Tilbury & Sons (Devon) Ltd v International Oil Pollution Fund 1971* and others, arising from oil pollution following the grounding of the *Sea Empress* off Milford Haven in 1996. CA, The Times, 27 February 2003. The ruling was that a shellfish processing company could not recover the economic loss that it had suffered as a result of oil pollution because it had no direct economic interest in the contaminated waters.

[241] Contained in the Merchant Shipping Act 1995.

[242] As in examples (c) and (d) above.

[243] See for example response to scenarios consultation by Soil Association.

tried to avoid this. In England, this is the general test for environmental damage under the law of nuisance and the test in *Rylands v Fletcher*, following the *Cambridge Water Co* case decided by the House of Lords in 1995[244]. The doctrine means that the threshold may change as scientific understanding advances, rendering a firm strictly liable if they fail to adapt their product or process accordingly[245].

Claiming through the courts

275. The process of obtaining redress through the courts can be disproportionately slow and costly, and also stressful. The premium lost on an individual crop because of adventitious presence would normally be a matter of hundreds or at most a few thousand pounds[246], whilst legal costs for recovery in a contested case could be many times as much. This is not an unusual situation: minor motor car accidents involve similar problems, which is why rather than going to court most such cases are resolved privately through negotiation, against the background of relatively clear rules as to liability, and within an active insurance market.

276. Even if there are coexistence protocols in force, people may want to test the legal provisions through the courts. If cases go to court, the dispute would be between users of two forms of agriculture, each of which is legitimate and is encouraged by Government policy. Under existing law it is uncertain how courts would rule on where economic loss should fall, and for a farmer growing GM crops, whether compliance with protocols would provide a defence. Courts would be unlikely to want to decide policy questions, regarding them as a matter for Government[247].

277. A new legal framework could be set by statute or could emerge over time from case law. Either way, it seems to us that factors to take into account should include:

- *For organic farming*. That organic agriculture should not be considered as an ultra sensitive use of land, particularly since the sector is one of those encouraged by Government policy, and since it is not sensitive to any other type of agricultural activity. The balance of reasonableness should be tested, however. Courts would have regard to any 'game playing' e.g. a farmer planting a small amount of a new crop very close to the neighbour's boundary in the knowledge of regular GM crop growing by that neighbour with, therefore, a likelihood of there being problematic adventitious presence would be unreasonable.

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[244] *Rylands v Fletcher* [(1868) L.R. 3 H.L. 330] had led to the imposition of strict liability on a person who, for his own purposes, had brought on to his land "anything likely to do mischief if it escapes". Later, the concepts of "natural" and "non-natural" use of land were introduced, with "non-natural" use being "some special use bringing with it increased danger to others, and ... not merely ... the ordinary use of the land or such a use as is proper for the general benefit of the community" (Lord Moulton in *Rickards v. Lothian*, [1913] A.C. 263 at 280). However, in the *Cambridge Water* case *(Cambridge Water Company v. Eastern Countries Leather plc,* [1994] 2 A.C.264) it was held that strict liability related only to foreseeable damage, even from "non-natural" uses. The issue in determining nuisance cases between landowners then becomes the foreseeability of damage, not whether the use of land was reasonable in relation to neighbouring land.

[245] Having statutory protocols in place would be expected also to remove uncertainty over whether a farmer growing GM crops would be found liable under Rylands and Fletcher. If he could show that he had abided by statutory protocols designed to achieve, then this would be expected to offer a defence against being found strictly liable.

[246] We have noted the possibility, too, of a possible claim from a GM producer for contamination of a high-value GM crop. This is difficult to quantify at this stage.

[247] Lord Goff ruling on determining policy questions: see paragraph 35 of Annex D for further detail.

- *For GM farming*. Adherence to protocols which had a statutory basis, Government backing or whose terms have been agreed by a wide range of interested parties should give the GM farmer a considerable measure of protection from litigation i.e. should provide a good defence. But without such a basis, a GM farmer's defence of compliance with protocols against a case brought by a non-GM or organic farmer would be much less secure. If protocols were non-statutory and not widely agreed among stakeholders, then the farmer suffering the loss may well be able to introduce as relevant the fact that neither he nor his representatives had been party to the protocol scheme.[248]
- *Extent of liability*. This should depend on the actual financial loss, and steps taken to minimise it. Factors would include how much income was lost e.g. whether it was from certain plants or the whole field; if a farmer had reason to suspect damage and loss, whether and what steps were taken by the affected party to minimise it; the reasonableness of extent of any organic decertification; and the general obligation on a claimant to mitigate damage, which here would include what steps were taken to sell the crop at the best price available.

278. Giving coexistence arrangements statutory backing would give much greater clarity to the courts and greater reassurance to farmers growing each kind of crop of the position in law. This is a good argument for making coexistence arrangements statutory. But the primary purpose of crop management protocols would be to seek to avoid problems arising in the first place to the maximum extent possible.

Insurance

279. The purpose of insurance is to increase the likelihood of compensation being available to those who suffer a loss. Insurance generally focuses on sudden and accidental damage, for which risks can be actuarially calculated.

280. There are two relevant kinds of insurance: third party liability insurance and first party insurance. Third party insurance would be where a GM farmer would insure himself against claims from other farmers. First party insurance would be where a farmer took out insurance to cover the possibility of his own crops decreasing in value as a result of adventitious presence.

The present position

281. Neither third party nor first party insurance would be available at present for UK farmers or seed producers in connection with the commercial growing of GM crops.

282. Insurance was not available to farmers who planted GM crops as part of the Farm Scale Evaluations. The largest UK agricultural insurer expressed the view[249] that the FSEs were part of the research and development risk of the biotechnology companies: their products were being tested, so they should accept responsibility for any damage. It advised its client farmers to ensure that their contract with the

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[248] The decision in the *Cambridge Water* case (See Annex D, paragraphs 34-35) is relevant also. It may have made at least have made it more likely than before that the cultivation of GM crops on agricultural land would be regarded as a "non-natural" use of that land. If the courts were to hold this (and it is by no means certain that they would) then the farmer responsible would be strictly liable for foreseeable damage caused by their escape, and the question whether that use of his land was reasonable in relation to neighbouring land would not arise.

[249] See NFU Mutual *Technical Bulletin on Genetically Modified Crops*, May 2000.

relevant biotechnology company did not leave them vulnerable to claims. It added an endorsement to its policy refusing indemnity "in respect of any liability arising from the production, supply of or presence on the premises of any genetically modified crop, where liability may be attributed directly or indirectly to the genetic characteristics of such crop. In particular no indemnity will be provided in respect of liability arising from the spread or the threat of spread of genetically modified organism characteristics into the environment or any change to the environment arising from research into, testing of or production of genetically modified organisms". The company said that it would review the position in the light of the FSEs.

283. We understand that useful insurance cover in relation to adventitious presence is at present unavailable to seed companies or farmers here and abroad, except possibly in Australia. Such cover was formerly available abroad but after some incidents (Starlink being the most notable instance) this was specifically excluded. Agricultural insurers will be reluctant to offer third party insurance for adventitious presence in the absence of clarity about whether a GM grower would in fact be liable for compensation and under what circumstances (e.g. proven breach of a protocol). Information about what in practice will be the market requirements in respect of adventitious presence levels and so what extent of loss might be expected would help, but in the absence of this and data about how often such thresholds would be breached in commercial practice, cover seems unlikely to be forthcoming.

Could insurance help?

284. Even if *third party insurance* was in principle available, in the absence of certainty of whether a farmer growing GM crops would be legally liable for loss arising from adventitious presence in a neighbour's crop, no insurance company would be likely to pay out in the event of a claim. Nor would there be much incentive for a farmer growing GM crops to take out third party legal liability insurance against claims, when liability remained unclear. If however a statutory coexistence framework had been put in place, and/or it had been established in case law the grounds on which a farmer growing GM crops or some other part of the industry could be held liable, at that point demand for third party liability insurance might grow.

285. And even if legal liability were clear, third party insurance would not necessarily deal with all cases where economic loss followed from adventitious presence. We have looked at three different sets of circumstances:

(a) when it is obvious which GM plot is the source of the adventitious presence, and that the GM farmer concerned has breached protocols.

(b) when it is obvious which GM plot is the source of the adventitious presence, but the GM farmer concerned does not appear to have breached protocols[250].

(c) when it is not obvious which GM plot is the source of the adventitious presence, and hence which GM farmer might be responsible.

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[250] Such cases should be infrequent for a 0.9% threshold, but they might arise for example if the protocols had not been set at the right levels to actually achieve the thresholds, or if the risk assessment or monitoring did not in practice deliver the required standards.

286. If abiding by protocols constituted a defence in law, and conversely breaking them made a farmer liable for damage arising through consequent adventitious presence, then a claim against the GM farmer's third party insurance would be expected reliably to offer compensation in the case of (a) but not (b) and in (c) only where one or more of the farmers could be proved to have breached protocols. So if farmers wished to protect themselves through insurance for 'no-fault' cases (assuming following protocols offered a defence) first party insurance would still be needed if non-GM farmers wanted reasonable assurance of compensation.

287. *First party insurance* would seem to be more likely to be offered by insurance companies than would third party insurance. It would not be adversarial in the same way as third party public liability insurance, because it would pay out to the policyholder without involving claims on other parties (unless it had been established in law grounds on which other parties would be held liable, in which case the insurance company would seek to recover its loss from the liable parties). The burden of insuring against protocol breaches in these circumstances would fall to the organic or non-GM farmer: or to the GM farmer if he chose to insure non-GM crops on his own farm from adventitious presence (or high-value GM crops from adventitious presence of non-GM material). A claim, particularly where the farmer had been at fault, would no doubt result in an increase in the farmer's premium in future years.

288. At present there is little first-party insurance in the UK for falls in crop value from whatever cause. It is likely that agricultural insurers would offer first party insurance for adventitious presence, were they to do so, as part of 'multi-peril' crop insurance cover. First party cover is available for seed crops that could lose value through, for example, admixture, and we understand that multi-peril commodity crop insurance is common in the USA and to a lesser extent in some European countries.

289. The insurance market tends to be slow to move into new areas. Insurers need to be able to quantify the cost and likelihood of losses, so that the costs can be spread over time and among a wider grouping[251], and experience takes time to build up. This is true for first and third party insurance. Because the risk of adventitious presence would be a new one in the UK[252], insurance firms have no basis on which to set premiums: they do not have claim histories to help them assess the risk itself, nor do they have evidence of the extent of precautions being put in place to protect against it. The existence of working coexistence arrangements would be essential for a first-party insurance market to develop: a market would not develop if economic loss from threshold breaches were routine and widespread. If occasional and relatively rare, then a market could develop, at least for the 0.9% threshold, although it cannot be guaranteed. A gradual take-up of GM crops, were they commercialised, should help insurance companies to build up the information they would need. Informal soundings with the insurance industry suggest that an initial managed period with intensive monitoring and auditing of coexistence arrangements would be attractive in this respect.

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[251] Re-insurance pools risks further, and the re-insurance companies have a significant influence over whether insurance is available for new risks.

[252] Though there is of course experience in other countries.

290. There would also need to be sufficient numbers of farmers seeking such insurance for insurance companies to be able to offer a product – we understand around 500 would be needed as a starting point. Insurers would have to take a view as to whether there would be that level of demand. Different crops would attract different premiums: those with the greatest risk of adventitious presence would be more expensive to insure – although the adventitious presence element of the premium might be mitigated by the crops being less expensive to insure against other sorts of risks (e.g. lower yield) if insurance against economic loss arising from adventitious presence was being offered as part of a multi-peril crop insurance package.

291. Overall, the evidence suggests that insurance would not in the short term[253] provide reliable compensation for any cases of loss and the prospects for it doing so in the medium term are uncertain, both for non-GM and organic crops. Aside from the unavailability of insurance, there is also an issue over whether it would be appropriate that farmers growing organic or exclusively non-GM crops should have to take out extra cover to protect themselves against the impact of other farmers' GM crops. If coexistence protocols worked effectively and incidences of loss were few, insurance costs for covering for threshold breaches would be relatively small and acceptable. But they might not be.

Other options for compensation

292. If and when an insurance market was in operation, the effect would be that different parts of the agricultural and food supply chain collectively would meet (through premiums) the cost of any economic losses arising from breaches of protocols. We recognise that there would be at the very least a transitional period while a first party, or, possibly, a third party insurance market developed.

293. We all agree that there should be access to compensation for farmers who suffer financial loss as a result of their produce exceeding statutory thresholds through no fault of their own. In principle insurance would be the best means of financial redress, but cover is unavailable at present, and there would remain the question of who should be responsible for paying insurance premiums. Data gathered during an intensively monitored introductory period of cultivation should help an insurance market develop, but this cannot be guaranteed.

Recommendation 5: There should be special arrangements for compensation for farmers suffering financial loss as a result of their produce exceeding statutory thresholds through no fault of their own, with a view to an insurance market developing in due course.

A compensation fund

294. One option would be to establish an indemnity or a fund to cover the types of economic loss for which insurance would later become available. There are precedents for such a fund, such as the statutory oil industry pollution fund[254]. And we understand that one of the options being considered by the Defra Working

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[253] This conclusion was corroborated by an informal survey undertaken by the farmers' campaign group farm 'No one will insure GM crops' *farm* press release 7 October 2003 (www.farm.org.uk)

[254] Though we have already noted the limitations of that fund in relation to indirect economic loss. (The oil fund is an ongoing, not transitional, fund.)

Group for Animal Disease Insurance[255] is an animal disease levy, which would create a fund financed by the livestock industry to cover part of the costs which might arise from outbreaks of certain exotic diseases, including compensation for those affected[256].

295. An indemnity or fund would provide significant reassurance for non-GM and organic farmers, particularly in an introductory period with the associated uncertainty about whether coexistence was practicable. The level of claims on the fund would provide data to insurers about how frequent claims for loss from adventitious presence threshold breaches would be likely to be under the coexistence system, in order to develop first and third party insurance products. Any indemnity/fund would need to be time-limited and reviewed regularly, as part of coexistence arrangements. Clearly if the fund were not time-limited, there would be no incentive ever for farmers to take out first-party insurance: the sensible thing to do (providing the fund was relatively easily accessible) would be to rely on a fund in perpetuity.

Options for financing a fund

296. How might any fund be financed, and how might it operate? There would be in principle a number of options.

297. The main possible providers of compensation in the absence of insurance cover would be Government; agricultural biotechnology companies or others holding GM consents; other parts of the agricultural supply industry, or a combination of Government and industry; or all farmers through a small levy on all harvested crops.

298. It would seem likely that the total of claims made would initially be relatively modest, if protocols worked reasonably effectively in relation to the 0.9% threshold and if the areas of GM and compatible organic cropping were relatively small (if compensation was available in relation to organic or other crops for lower thresholds). The extent of claims would depend on the factors (as discussed in parts 2.3 and 2.4 above) that would impinge on whether coexistence would be practicable, so the same uncertainty in relation to that question means that the picture on possible claims is also unclear at this stage.

299. Contributions to a fund or indemnity could in principle be either mandatory or voluntary. A voluntary system would not need legislation. Some of us think that a compensation scheme would need to be *statutory* to command the confidence of farmers who might stand to make a loss. It is not clear that a mandatory fund would be consistent with EU law: it would depend on whether it was considered proportionate in the context of developing coexistence measures.

300. Some of us take a firm view that the compensation scheme should be the responsibility of one or more of the economic beneficiaries of GM crops, with the *agricultural biotechnology industry taking responsibility for the fund/indemnity*,

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[255] Which has conducted discussions with the livestock and insurance industries about animal disease insurance to develop proposals for a fundamental overhaul of animal disease compensation arrangements.

[256] HM Government, *Response to the Foot and Mouth Disease Inquiries*, November 2002. (Both of these examples, it should be noted, relate to clearly harmful events. The harm in relation to GM crops to which the fund would apply relates to adventitious presence alone, and the use of the examples accordingly is qualified in that respect.)

possibly negotiating with seed suppliers and farmers' representatives an appropriate division of costs among the financial beneficiaries of GM crops.

301. Our understanding is that it the agricultural biotechnology industry would be unwilling to underwrite a compensation scheme for any losses related to 0.9% and even less willing to do so for breaches of thresholds lower than this. We understand that seed companies, given the impact on their business of responding to thresholds for adventitious presence in any case, would view the prospect in addition of contributing to a compensation fund for farmers quite unacceptable. Some of us fear that an industry-funded compensation scheme would become in effect an additional barrier to market entry of GM crops; set a bad precedent for GM cultivation elsewhere; and would be presented by opponents not as industry responding to concerns and promoting good stewardship but as evidence that GM crops are 'dangerous' or 'different'.

302. If the cost fell to the agricultural biotechnology companies, they would try to raise it out of the price of their products to the seed industry and to the farmer. This would mean that GM products would be less cost effective to the farmer, which would have an impact on his choice of whether to use the technology or not. Even were some agricultural biotechnology companies to decide a scheme would be a good idea, some others might refuse to do so because the risk of adventitious presence would vary between different GM events, and between different species. Some smaller companies involved in the supply chain might decline to contribute[257] for similar reasons or because they would not have the financial standing to be able to do so.

303. The option of funding a compensation scheme based on a *levy on the sale of GM seed*, in accordance with the principle that economic beneficiaries of sales and use of the technology should contribute proportionately, would also be an unacceptable way forward for the agricultural biotechnology industry. This is because such front-loading of the potential costs onto seed sales would be costly to administer and could in itself constitute an excessively high barrier to entry into the market of GM crops.

304. A different option, likely to be more acceptable to the agricultural biotechnology industry, but perhaps not to all farmers, would be a small *levy on harvested combinable crops* (say 1 penny per tonne) which could be levied relatively easily (a similar scheme operates already to fund research into combinable crops). This would spread the costs more widely than simply GM crops. That would accordingly deal with the objection of singling out GM crops but attract the corresponding negative aspect of being seen as an unwelcome burden on those farmers who do not want GM technology.

305. Although *Government* has indicated that it will be considering policy on coexistence, it seems highly unlikely to contribute to a fund or offer an indemnity, given reluctance to set precedents for other aspects of agriculture and other situations. Indeed, there is desire to move away from state compensation for economic loss and more towards market-based and insurance-based solutions, for example for livestock disease.

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[257] Such as those working with horticultural crops and smaller scale agricultural crops.

306. Were Government to decide that there should be compulsory contributions from others to a fund, this would almost certainly require legislative backing, since it would in effect be a new tax. In any case, if a fund rather than an indemnity was set up and was not needed or necessary only in a small number of cases, one would expect it to be returned to its contributors.

307. As with the design of coexistence arrangements in relation to 0.1%, we are divided about whether compensation should be available to farmers not just where the 0.9% threshold is exceeded, but right down to a 0.1% threshold. Some of us believe that this is essential. Among those of us who think compensation should be available, the weight of opinion is towards GM consent-holders and/or Government funding it rather than farmers through a levy on harvested crops. Others of us believe that it would be unreasonable to expect compensation from any source other than the organic certification bodies, because the threshold is self-imposed rather than statutory. This in effect would be funded by organic farmers through their fees to those bodies. Compensation in any case would be expected to be available for a limited period, to promote development of an insurance market.

Options for operating a fund

308. Any compensation fund or indemnity faces the task of determining the validity of claims, which might initially be particularly hard in this unfamiliar and highly contested area. It would be important that the contributors to a fund or indemnity had protection against malicious or unreasonable requests for compensation.

309. Any claimant on a fund would have been expected to take reasonable steps to minimise the likelihood of breaching the relevant adventitious presence levels, and to mitigate loss by selling the crop. The threshold breach would be expected to be assessed on a whole-field basis, not, say, a field-edge. The claimant would be able to claim only for the loss of any non-GM or organic premium arising from adventitious presence.

310. The claimant would also need to show – by means of testing – that he or she had suffered the loss through adventitious presence. A further option would be to refund the cost of testing for farmers who successfully claim compensation on the basis of a test result showing a breach of the relevant threshold. Refunds could be offered on the basis of testing done on a final batch of a crop rather than on each field (if there was more than one field): the principle would be refunding of costs, which could be justified in proving the case for verifiable, reasonably mitigated loss.

311. In order to guard against claims from 'careless' farmers or 'game-playing', membership of a recognised conventional or organic crop assurance scheme could be made a condition of claiming against the fund (this could be made to apply regardless of how any fund was financed). Or an independent expert tribunal could be appointed to adjudicate on the cause of adventitious presence leading to economic loss, on the extent of the loss, and on whether compensation was warranted[258]. There are precedents where interested parties can stand behind

[258] Any such tribunal would need to comply with the principles laid down by the Council on Tribunals. The Council takes the view that proceedings in a tribunal should make the tribunal easily accessible to members of the public who would like the tribunal to deal with their case; be cheap, quick and as informal as possible; provide the right to an oral hearing; be held in public; conclude with the tribunal giving adequate reasons for its decisions; have time limits where necessary to prevent delay (although these limits should not be too short); and be seen to be independent, impartial and fair to all.

claims on an insurance fund but where the administration and cash flow would be taken on by the insurance industry, providing the process and the liquidity to fund prompt payment of claims before (for example) levies are collected. This would be another possible way of running a compensation scheme.

Insurance for seed producers

312. Aside from individual farmers, seed companies may wish to protect themselves for cases of adventitious presence in seed production. Seed companies at present generally can only get insurance cover for inadvertent release if the contamination level is above 5%. This would only ever occur if something went wrong with the gateway GMO testing all companies do and if there has been a serious mix up in the seed processing plant: not through pollen flow during seed production.

313. So the insurance available would not cover the highly unlikely but catastrophic scenario for a small seed company facing massive financial consequences of issuing seed with a high level of adventitious presence that had knock-on effects on farms and up the food chain, exposing the company to a financial claim that would instantly render them insolvent. These are precisely the circumstances where they (and indeed, their customers) need the company to have insurance cover. The UK seed production market is composed of quite a large number of small seed companies. Informal soundings suggest that this position could be changed by seed companies working with the insurance providers, supported by providers having access to independent experts who can help them assess what the real risk is.

A tribunal could either be established through statute (in which case its decisions could be binding in law), perhaps as part of coexistence regulations and creation of a fund; or be set up informally as part of the coexistence regime, without statutory backing (in which case its decisions would be binding only if the parties in the dispute agreed to this). Panel members could be independent lawyers or lay people appointed by Government. Tribunals currently operating in the UK include agricultural land tribunals, the meat hygiene appeal tribunal, the Lands Tribunal, and the London Parking and Traffic Appeals Service, which adopt a variety of approaches.

PART 3 LIABILITY FOR ENVIRONMENTAL IMPACTS FROM GROWING GM CROPS COMMERCIALLY

The issue

314. Our discussion up to this point has considered the question of coexistence and possible economic loss arising from the possible impact of GM cultivation on other crops. We turn now to the question of redress for damage to the environment more generally.

315. To do so is not to assume that there is a foreseeable risk that commercial cultivation of GM crops would cause environmental damage. As we noted earlier in the report, the Science Review Panel's first report[259] found no scientific case for ruling out all GM crops and their products, although neither did it give them blanket approval. The Panel found that, for the current generation of GM crops, the most important issue was their potential effect on farmland and wildlife.

316. The very definition of what might constitute "damage" to the environment raises difficult questions. Some impacts on the environment might be short-term and reversible; some might be indistinguishable from the effects of traits produced in crops by conventional selective breeding; some might be positively beneficial[260]. Impacts might be direct; or they might be indirect, such as through changing patterns of agricultural land-use or the use of different types of herbicide at different levels of concentration. Like other issues relating to GMOs, liability for harm cannot be a black and white issue. The possible use of GM crops must be assessed in the general context of modern agriculture, including:

- the environmental impacts of growing other crops; existing agronomic practices and their impact on the environment;
- the options for adapting these practices as part of new strategies for farming, and the potential role of GM crops in that process; and
- judgements about how GM crops would be used in practice and whether and to what extent they can be part of solutions to negative environmental impacts of agriculture.

The results of the FSEs have brought renewed focus on judgements of this kind and important new data to inform them in relation to GM crops and their conventional equivalents.

317. Nonetheless, a question that often comes up when debating GM, and did so in many of the *GM Nation?* activities, is who should bear responsibility for any adverse environmental impacts in the long-term as a result of growing GM crops? Who should take responsibility for putting matters right, if putting right is possible? In the light of past experiences where things have gone unexpectedly wrong, for

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[259] GM Science Review Panel, First Report, 21 July 2003. (Available at http://www.gmsciencedebate.co.uk) The Science Panel has reconvened in autumn 2003 to consider its findings in the light of the results of *GM Nation?*, further scientific data, including the FSE results, and comments on its first report.

[260] ACRE points out that "if a release brings about changes to the *status quo* it does not automatically follow that these changes are harmful" (*The criteria used by ACRE to gauge harm when giving advice on the risks of releasing genetically modified organisms to the environment 5 July 2002.* http://www.defra.gov.uk/environment/acre/harm/index.htm).

example BSE, people want any uncertainties to be acknowledged ahead of time, and they want a plan of action in case they are realised[261]. The uncertainty over what if any significant environmental impacts might arise from commercially growing GM crops means, however, that the design of rules for liability must take place more on the basis of hypothesis as to the character of possible impacts, and analogy with existing liability systems, than actual experience.

318. There is a divergence of view on the Commission on the general approach to liability. For some of us the starting point is that a sceptical public will only be convinced that the biotechnology industry would take responsibility for anything that went badly wrong in the future if a more rigorous liability regime is put in place. These members believe that GM crop consent-holders should be held absolutely liable for any environmental harm arising from the results of their products, with no defences. If the products are safe – indeed potentially beneficial if grown appropriately – for the environment as the companies claim, then surely companies should be willing to accept this obligation?

319. Others of us believe that it would be wrong to single out GM for special treatment. They argue that there is no need to fashion for it a more rigorous liability regime than applies to other environmental damage. Moreover, they feel that, while the agricultural biotechnology companies involved stand behind the safety and usefulness of their products, a more rigorous regime would effectively put all GM crops in the same category in the public mind as 'dangerous' products (such as oil or toxic chemicals), which obviously can and do directly damage the environment if spilt or misused.

The limits to liability regimes

320. Liability regimes have a simple purpose, which is to require those who cause harm to take action to cease doing so, to remedy or clean up any damage they have caused, and to compensate others for loss arising from their actions. They are in theory *ex post* regimes. The regime has no effect in law until damage has occurred,

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[261] In *Crops on Trial* we said that those who regarded GM technology as "different" saw it not simply as an advance in molecular biology, but a major and irreversible watershed in human intervention in nature. From this point of view, "there are worries about possible undesirable outcomes – the inherently unpredictable future mishaps or surprises (the 'unknown unknowns') which could follow a commitment to rapid agricultural deployment of GM technology ... [They] fear that it will not in fact be possible to contain and manage the risks, and that any adverse effects resulting from the release of GMOs might not be reversible. They claim that there may turn out to be significant gaps in scientific knowledge, citing in justification the historical experience of the effects of other new technologies". Some of those who see GM as a watershed argue that one aspect of the concern, the issue of unanticipated consequences beyond the purview of present scientific (and hence regulatory) understanding, is perhaps the central reason for continuing public and political concern about GM crops. "The problems concern not only what GM science 'knows' – but also what that science does not, and perhaps even cannot, know" (Robin Grove-White and Brian Wynne, *Science and public responses towards GM crops: some reflections for the Government's Chief Scientific Advisers*, IEPPP, Lancaster, June 2002.) Two recent studies by respected overseas bodies (Royal Society of Canada, *Elements of precaution: recommendations for the regulation of food biotechnology in Canada*, Ottawa, Ont. RSC, 2001 and Plant Research International, *Crops of an uncertain nature? Controversies and knowledge gaps concerning genetically modified crops*, PRI BV, Wageningen, 2001) discuss areas in which there are continuing scientific uncertainties and unknowns about GM crops and their potential impacts. These are "phenomena lying outside the purview of approaches to risk assessment as presently practised, [which] by definition are concerned with *specifiable* known and potential effects, and with the *known* uncertainties which surround the material manifestations of such effects. By contrast, 'unanticipated effects' ... relate to the distinct, but officially unspoken and unacknowledged, domain of *ignorance*, from which may emerge unknown, unpredicted consequences" (Grove-White and Wynne, *op cit.)*.

or there is a sufficient threat of it occurring to warrant a court granting a preventative order.

321. But liability regimes are also *ex ante* in effect. They induce responses in those at risk of being held liable. The prospect of exposure to a strong liability regime will lead them to raise their levels of precaution in undertaking the activity concerned. There are various ways by which liability rules can be tightened up: by taking away the requirement for the claimant to prove fault or negligence on the part of the defendant, for example (strict liability), or taking away also the requirement to show that what the defendant did could have been foreseen to be likely to cause the harm complained of (absolute liability); or reversing the burden of proof, so that instead of the claimant proving that the defendant caused the damage, requiring the defendants to prove that they did not. There are related issues: should the defendant be allowed to offer defences, such as to establish that their acts were wholly authorised – or even required - by administrative permits, or were in accordance with the state of the art of scientific knowledge.

322. But no matter how a liability regime is established, it is still a highly constrained process with distinct limitations. Any system that is dependent upon legal proceedings requires a solvent claimant able to bear the potentially high cost; more importantly, it requires a solvent defendant able not only to bear the cost of the proceedings but also to foot the bill for remediation and compensation.

323. It also requires a capacity to distinguish between different causes of the damage, and between different potential defendants, not only to assess which of them are liable, but also to apportion liability equitably between them. Liability rules work best in relation to sudden accidental damage, and less well in the context of long term, cumulative, diffuse effects. Adverse environmental impacts of growing GM crops, just like other changes in agronomic methods, are likely to fall into this category, and be difficult if not impossible to attribute in respect either of cause or causers. Much adverse environmental change has been brought about by past agricultural practices without any thought of recourse to liability; and there is currently no potential liability for damage from plants sold in garden centres or otherwise introduced that escape into the wild.

324. At an early stage in developing our approach to liability, a working group of the AEBC consulted on several hypothetical scenarios involving hypothetical direct and indirect environmental impacts[262] from commercial cultivation of GM crops, including the effects of monoculture on soil, plants and insects; direct ecological effects; and indirect effects on groundwater. Most respondents saw the scenarios as not GM-specific; and considered that the environmental impacts of GM crops, as for other crops, may well be diffuse and may well not be GM-specific.

325. Another important limit on liability is where any impacts are irreversible. Some of us take the view that it is inevitable that some impacts of GMOs will be irreversible, and consider irreversibility to be one of the key issues for many people in respect of GM crops. In this situation, it will not be possible to put things right with any money gathered by apportioning liability. It may not be possible to mitigate impacts. Any harm would simply have to be accepted and adapted to. The aim of the

[262] A summary of responses to the scenarios consultation is on the AEBC website (www.aebc.gov.uk)

regulatory regime, and any information gained from post-commercialisation monitoring, should be to avoid any prospect of significant irreversible damage.

326. So there are inherent limits to any system of liability, which need to be understood from the start. Even a heavily modified regime will fail to cover risk completely. Where liability fails, environmental damage either goes unremedied, or responsibility rests, by default, with the state.

Unforeseen environmental impacts

327. An established regulatory procedure precedes the deliberate release of GMOs. The legislation provides that a GMO may only be approved for release to the environment in the UK if consent has been granted following a rigorous assessment of the risk of harm to human health or the environment. The GM sector in this respect in the EU is highly regulated compared with other novel crop developments. The regulators need to be satisfied that the crop is at least as safe to human health and the environment as its non-GM counterpart. The law also requires monitoring and evaluation of GM crop growing[263].

328. These regulatory arrangements are important, but however rigorously they are designed and applied they can offer no absolute guarantee against harm being caused. Every regulatory system involves a trade-off between preventing negative effects and the imposition of unacceptable financial costs, and no system can give complete certainty of preventing adverse effects, let alone ensuring that operating rules are fully complied with. They proceed on the basis of a science-based risk assessment.

329. GM is no different in this respect from any other new or even existing technology. All have a capacity for unforeseen effects, either of themselves or because of human error in their use. Commercial cultivation of GM crops might cause damage to the environment of a kind or to a degree that was not foreseen or even foreseeable at the time of the risk assessment. The same possibilities apply to new, conventional crop varieties. Even those of us who say that the "you can never say never" argument must not be used to stop technological developments that could benefit farmers and the environment, can agree that it is important that there is an adequate answer to the question of what would happen if something unexpected went wrong[264].

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[263] In the hypothetical case of a particular GM crop being found to cause direct, attributable environmental harm, the first step would be for it to be withdrawn from the market and removed from the environment. Government has two sets of administrative powers under existing legislation to do so, one operating *ex ante* and the other *ex post*. First, where a GMO is identified as being in danger of causing imminent harm to the environment, action can be taken under the Environmental Protection Act to bring about its removal. Second, if evidence came to light that a GM crop had already caused harm to the environment or human health, the UK authorities could use emergency procedures authorised under the Deliberate Release Directive to stop its sale and continued use in all or part of the UK (Article 23 of the Deliberate Release Directive (2001/18/EC) provides that a Member State may provisionally restrict the use and/or sale of a product on its territory where justifiable reasons to consider that the product constitutes a risk to human health or the environment have arisen since the grant of its Part C approval).

[264] Proponents of GM crop technology argue that the way to find out more about an organism's physiology or biochemistry is by a careful step-by-step approach through trials, followed by monitoring as use is scaled up. They recognised that any unwanted effects of changes in agricultural practice could take a long time to reverse, but argue that this is a more general problem, not related only to GM crops. They consider that the risk of unknown outcomes should be balanced against the risk of not growing GM crops, which would include forfeiting any potential environmental and health benefits from such crops. They argue that opponents of GM crops are

330. There is a range of views among us about the likelihood of any significant negative impact arising from commercially growing GM crops that have been assessed as safe for release into the environment. However, we are focussing here on the hypothetical issue of what would happen if a significant negative environmental impact was detected that needed to be put right and could be put right, or at least have its negative impact lessened.

331. If some environmental change were found to have been caused by cultivation of a GM crop, there would be several issues to resolve, including:

- whether that change was tolerable and was likely to continue to be so, whether it should be curtailed, or whether it constituted environmental damage that ought to be reversed if possible, or at least minimised;
- who should be able to require action to be taken to reverse or minimise any damage (e.g. the State as regulator, and/or a landowner whose property was affected); and
- who should be liable (e.g. the state, the farmer, the seed-supplier or the consent-holder) to undertake and/or pay for any required remedial action and/or to compensate those suffering loss, and in what order of priority for exposure?

Existing liability rules

332. Redress for environmental damage is provided by two principal sets of legal rules. First, rules relating to civil liability, where the claimant, perhaps the owner of adjoining land, may sue the responsible party for an award of compensation (damages) in respect of loss arising from damage to person or property, and/or an order (injunction) to prevent further loss from occurring. There are several potential heads of liability under the law of tort, including nuisance, trespass, negligence and the rule in *Rylands v Fletcher*. These rules require the claimant to have sufficient private ownership of the environmental good to be able to demand compensation for its damage.

333. Second, rules of administrative liability, where the right of action is given not to an individual, but to the state. In some cases the two systems will overlap, but the development of administrative liability has proved necessary because of the limited extent to which civil liability rules are able to protect the general environment beyond

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highly selective in their choice of adverse impacts of technology; and that there are many examples where technological advance, for example in construction, engineering, pharmaceuticals, food and farming, has not produced unforeseeable negative impacts, or at least none that have outweighed the gains in quality of life secured by the technological progress. Those adopting this viewpoint consider that the likelihood of any substantial problem is remote, given all the regulatory controls and the mechanisms for monitoring and inspection. They would place emphasis on putting effective monitoring regimes in place, so that these would give early warning if there were emerging problems, and then dealing with problems swiftly, before they could escalate. They emphasise that environmental impacts of commercial growing of GM crops will be similar to those of growing their conventional equivalents, and therefore see no justification for singling out GM crops as more likely to produce negative environmental impacts than other crops. They say that society normally deals with risk from new technological developments by means of regulation to avoid harm, and there is nothing in the case of GM crops that warrants a departure from that principle (particularly since GM crops are regulated in the EU more rigorously than any other new crops). They also dispute the notion that the FSE sites themselves attracted significant local attention, let alone significant damage to the crops; arguing that in the great majority of cases the events attracted little or no 'tension': quite the opposite.

private property. The unowned environment is outside the range of civil liability[265]. In relation to habitats and biodiversity, for example, there will usually be no individual with a protectable right recognisable in law who would be able to bring a successful case[266]. Moreover, any loss suffered would be indirect rather than direct, and it would usually be impossible to quantify economic loss: both because the effects may be diffuse and because it may be unclear for what purpose damages would be awarded because there would be no economic loss suffered by the claimant. So even where there is a private right of action, it will extend only to the claimant's financial loss, and not to the cost of remediating environmental damage[267].

334. A rule of administrative liability confers broader power on the state. It usually empowers a regulator to undertake remedial works and to charge the cost back to the responsible party; or to require the responsible party to do the work itself. Examples of such special administrative liability regimes exist in relation to water pollution and contamination of land. The regimes are typically widely cast: they require proof of causation (i.e. they impose liability only on those parties who caused or knowingly permitted the damage to occur) but they then create liability irrespective of whether the person who caused the damage acted negligently (in other words, they give rise to strict liability), irrespective of whether such damage might have been anticipated as a result of those parties' acts or omissions (i.e. not requiring proof that the damage was foreseeable) and they may even (as with contaminated land) be retrospective in their effect. However, the potential strictness of the regime is mitigated in practice by the broad discretion conferred on the regulator as to whether to pursue a remedy at all and if so, to what extent and under what conditions.

335. There is already an administrative liability regime for GMOs within the 1990 Environmental Protection Act (EPA). Part VI contains provisions whose purpose is "...preventing or minimising any damage to the environment which may arise from the escape or release from human control of genetically modified organisms"[268]. However, the remediation provisions are expressed in rather general terms, and can only be used if the responsible party has been convicted of an offence under section 118 of the Act. Where a person is convicted of such an offence under subsections s118 (a)-(f)[269] "in respect of any matters which appear to the court to be matters which it is in his power to remedy", as well as or instead of imposing a punishment the court may order him to take specified steps to remedy the harm (s120).

336. Additionally, where committing an offence under those subsections "causes any harm which it is possible to remedy", the Secretary of State may "arrange for any reasonable steps to be taken towards remedying the harm[270]; and recover the cost... from any person convicted of that offence" (s121).

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[265] The issues considered here refer back to the discussion of economic liability in Part 2.5, where we set out a fuller analysis of the principles of liability. As acknowledged in Part 2.5, this analysis draws heavily from Richard Burnett-Hall's review at Annex D.

[266] Under the draft European Environmental Liability Directive, those who might be directly affected by damage and qualified entities (such as NGOs) would be able to request action by a competent authority against a liable operator, and seek judicial review on their action or inaction – but that is not the same thing as having a protectable right.

[267] See for example the Cambridge Water Company case (details are in Annex D)

[268] s106 of the EPA

[269] Being the subsections dealing with actions which could directly cause harm.

[270] Subject to the permission of any third party in occupation of land where the steps are to be taken or which may be affected by the steps taken.

337. So the UK competent authorities have power already to undertake remedial work for harm caused by the release of GMOs, but the cost of doing so can only be recovered from those responsible if they have been convicted of a criminal offence under the Act. This arrangement is out of line with the other administrative liability regimes under the Act, where criminal and administrative liability is kept separate. In the case of contaminated land there is no relationship at all; in the case of water pollution, administrative liability arises only if the entry of the polluting substances into the water system is in breach of a permit.

Principles to follow in amending the present liability regime for GM crops

338. It would in theory be possible to build upon the existing regime for private civil liability, but it would require a new and complex system of substantive rules and new procedures. There would need to be a sufficiently clear definition of the concept of environmental damage to enable a court to assess liability on the basis of evidence. Fresh consideration would need to be given to the type of liability (e.g. fault-based, strict or absolute) and to the defences that might be available to a defendant, such as regulatory compliance (i.e. whether the action complained of was within the scope of, or even required by, the permit under which the operator was acting), state of the art, or third-party intervention.

339. The right to bring proceedings would need to be extended beyond the present class of property owners or occupiers, so as to include interest groups, or members of the public at large. So too the scope of available remedies, as to whether they might include, in addition to direct costs of remediation, some form of damages to reflect possibly irremediable harm done to natural resources. These matters have been extensively reviewed in the legal literature, and in the discussions in Europe over the past 20 years about the possible approach of a directive for environmental liability. The thresholds for liability, and the possible defences, have been amongst the most controversial elements of the debate.

340. If civil liability were to be the model for other types of environmental liability, it would make sense to follow a similar course for environmental liability in respect of GMOs. But it is now highly unlikely that this will be the case. Instead, the emergent draft EU directive on Environmental Liability (ELD), whose provisions explicitly extend to environmental damage from the release of GMOs, has turned its back on an enhanced civil liability regime, and moved instead towards a regime of administrative liability.

341. The draft ELD, a Common Position on which was adopted by the European Council in September 2003[271], is currently making its way through the legislative process. Based on the "polluter pays" principle, it is aimed at prevention and remediation of significant damage to water, land and biodiversity. It has taken many years for the Directive to be developed by the European Commission and European Parliament in discussions across Europe with stakeholders, but we understand that it may now be adopted within the next year, perhaps in advance of the next elections to the European Parliament scheduled for May 2004.

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[271] Common Position adopted by Council, 18 September 2003 (10933/03)

342. The draft directive follows a model of administrative discretion. Where environmental damage occurs, it will be the competent authority of a Member State that will have the right to undertake remediation, and to take proceedings against the responsible operator to recover the cost. There will be no right of individual action, beyond that already available under civil law rules. However, so-called "qualified entities" (among which are non-governmental organisations) will have the right to require the State authorities to consider taking action (as with judicial review at present).

343. The main features of the draft Directive as it presently stands are:

(1) The prospect of environmental damage being caused by the release of GMOs to the environment is recognised by the draft Directive, and included in the list of activities to which strict liability applies.

(2) The concept of "environmental damage" is limited to damage to protected species (wherever occurring) and damage to protected natural habitats (as designated in the legislation), being damage which has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species. It does not, therefore, extend automatically to some types of environmental change that have featured in the literature, such as gene flow or gene-stacking. Liability would only be triggered when the effects were significantly adverse to the favourable conservation status of some protected species or habitat. Even then, there would be no compulsion on the authorities to act. An earlier draft contained a duty on Member States to undertake remedial action, but was opposed by all 15 Member States, and has now been reduced to a power, underpinned by a right of environmental groups to require State authorities to consider undertaking remediation. Nor would the GMO regime automatically extend to the impact of herbicide regimes associated with the cultivation of GM crops, unless they could be shown to have such effects. Member States have power to extend the list of protected species or habitats for the purposes of the directive.

(3) The exclusion of traditional damage, i.e. bodily injury and economic loss. The right to pursue remedies in such cases does not shift to the state but remains with claimants who have sufficient economic interest to maintain a claim.

(4) The primary responsibility to remedy environmental harm lies on the Competent Authority of the Member State. They have the right to recover their costs from the operator of the process that caused the damage. There is no requirement of prior criminal proceedings. Instead of the series of clearly defined defences with mandatory consequences that would be required if a civil liability model had been adopted, there is a series of decisions to be made by the Competent Authority, some of them carrying mandatory consequences, and some of them discretionary. For example, operators must be absolved from contributing to the cost if they can prove that the damage was caused by a third party, or resulted from a compulsory requirement of the regulator. On the discretionary front, the Competent Authority may waive the cost if the operator demonstrates he was not at fault and that the emission or event was expressly authorised by his permit; or that it was in accordance with the state of the art. This approach softens the decision-making in a way

that is possible only because the decisions are to be taken by a politically accountable regulator rather than by a court.

(5) A 5-year limitation period for commencing proceedings and no retrospective effect.

(6) Member States will have the power to adopt more stringent measures, including the identification of additional activities and of additional responsible parties.

(7) Member States will be required to encourage the development of financial security instruments and markets, such as in insurance and guarantees.

(8) A specific reporting requirement for GMOs is imposed under Article 18, which requires a review of the application of the Directive to "environmental damage caused by genetically modified organisms particularly in light of experience gained within relevant international forums and Conventions, such as the Convention on Biological Diversity and the Cartagena Protocol on Biosafety, as well as the results of any incidents of environmental damage caused by GMOs". The report is not required until 10 years following adoption of the Directive.

344. We believe that the draft Directive provides a platform upon which Government should build. Should it be adopted in its present form in 2004, it will require Government to take steps for its complete transposition into national law within two years. It will include, as we have seen, damage caused by the release of GMOs. Nonetheless, there may still be delays to the final adoption of the Directive by the EU and, more importantly, there are significant limitations in its scope, as described above. We therefore recommend that Government should use the general approach of the Directive in fashioning a separate UK liability regime for any damage caused by the release of GMOs to the environment.

Recommendation 6: Government should use the general approach of the Draft EU Liability Directive to develop the UK's liability regime for any damage caused by the release of GMOs to the environment

An interim position

345. We believe that the EPA should be amended so that it would be no longer necessary to obtain a conviction in the criminal courts before being able to require environmental remediation in the case of GMOs. The need for criminal conviction is wrong in principle and is out of line with other existing administrative liability schemes and with the draft Directive.

Recommendation 7: The Environmental Protection Act 1990 should be amended to allow the competent regulatory authority to require environmental remediation where reasonable and appropriate in respect of environmental harm caused by the release of GMOs, irrespective of criminal liability.

346. The EPA should also be amended to follow the model of other statutory environmental regimes in conferring power on the regulator to require a GM crop

consent-holder or other responsible party to carry out specific works of remediation, or to contribute to the agency's own costs in carrying out those works itself.

347. As with the draft Directive and with other existing regimes of administrative environmental liability, this amendment would give discretion to the regulator over whether to seek remedial action or recompense from consent-holders. In the exercise of that discretionary power the regulator would be subject to supervision by the courts, at the instance of members of the public or non-governmental organisations, through judicial review on established principles. The advantage of discretion over obligation is that at the time any harm became apparent, Ministers or another regulatory authority could take a proportionate view on whether remedial action would be justified, to what extent it should require consent-holders or other responsible parties to act or to pay and to what extent the state should accept responsibility.

348. If a consent-holder were unhappy with a discretionary decision to require remediation, it would be open to them to seek judicial review or a statutory appeal procedure could be provided.

Defences

349. Some of us believe that consent-holders and/or seed-suppliers should be allowed a defence of permit compliance or state of the art against their being held liable for remediation of any negative impacts caused by a particular GM crop. Others of us feel that no defences should be offered. However, we see merit in adopting the approach of the draft Directive under which some defences are absolute and some discretionary.

Financial security

350. The model of administrative liability we have proposed above imposes primary responsibility on the state, with a right of recovery of costs against operators responsible for causing the damage concerned. If the defendant has insufficient assets to pay the bill, in whole or in part, the state is left with the burden.

351. It is important therefore to consider options that might improve the financial security of potential defendants. We have identified two: insurance, and a remediation fund.

Insurance

352. Unless all potential defendants hold adequate insurance cover, legal liability schemes may prove futile. This has been a stumbling block for many proposals seeking to impose liability for various forms of environmental harm and to make obtaining adequate insurance cover mandatory. As in relation to economic losses from adventitious presence, before entering a market, insurers need to be able to estimate both the potential cost of individual losses and their likelihood.

353. Insurers might be encouraged to offer insurance for the cost of environmental remediation if there were provision for capping, limiting their liability to proved loss of up to a certain amount, with the Government meeting any loss above that amount. This idea has been considered in developing the proposed Environmental Liability Directive, where the European Commission has commented that "capping liability for

natural resource damages is likely to improve the chances of early development of the insurance market in this field, [though it] would erode the effective application of the 'polluter pays' principle"[272]. The draft Directive does not go down the road of setting limits to liability, but it does call for evaluation of the possibility of a cap once the Directive is in force.

354. However, that would not help on the issue of the likelihood of claims: the unknowable nature of the potential risks does not lend itself to an actuarial approach. Post-commercialisation monitoring might be of some use to insurers in assessing whether environmental problems arise in the short to medium term. Moreover, channelling liability into an administrative model, rather than opening up the civil liability route, may reduce the risk of exposure to extravagant and unjustified claims. Even then, if, as is common, insurers offer only "claims made" policies, (which provide cover only for claims made during the relevant policy year, or sometimes shortly after), rather than "occurrence" based policies (which cover all claims, whenever arising, from any harmful occurrence during the relevant policy year), the problem remains of how to cover the possibly lengthy "tail" of liability that will persist after the relevant activity has ceased.

355. We judge it unlikely that insurance cover will become available in relation to environmental harm from GM crops, at least in the near to medium term. Our informal soundings of insurers are consistent with this conclusion; and a recent survey of the principle insurance underwriters in the UK, carried out by the farming interest group *farm,* suggested the same. The survey also revealed that several companies have set specific exclusion clauses for liability arising from GM crops, which they do not anticipate changing if commercialisation is approved[273]. We must acknowledge that, without any insurance cover, payment of damages awarded cannot always be guaranteed.

A fund for environmental remediation

356. Some of us argue that responsibility for the possible impacts of the introduction of a new technology should lie with those who will benefit most directly from it; and that the agricultural biotechnology industry and possibly other beneficiaries should finance or underwrite a fund[274] to remediate adverse environmental consequences arising from GM cropping. As well as direct impacts, this could include the costs of remediation of any long-term diffuse and unattributable damage.

357. Some of us think that a fund of this kind is essential, otherwise companies may use other means to avoid liabilities and leave the state and hence taxpayers to accept all the costs. In addition, some of us think that it would increase public confidence because of the obvious support by the industry for its products. Others of us feel that opponents of GM would present any such fund in quite the opposite way, i.e. as demonstrating an acceptance by the agricultural biotechnology industry that GM crops were unsafe or negatively "different" from their conventional counterparts. Some stakeholders were very doubtful about a fund for environmental remediation,

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[272] 9 February 2000 EC White Paper COM (2000) 66 http://europa.eu.int/comm/off/white/com2000_66.htm

[273] *farm* press release of 7 October 2003, http://www.farm.org.uk/

[274] Not to be confused with the fund which might be set up to provide compensation for economic losses due to adventitious presence

on the basis that: it would be difficult to define the events a fund would cover and to determine the cause; the demands on it would potentially be unlimited, making the level of contribution for companies to make at the outset very difficult to determine; it is not clear which parts of industry should pay; and a GM-specific fund would not cover other impacts on the farmland environment of concern to society.

358. On balance, most of us think that setting up a fund to try to cover environmental remediation would not be the right solution. Rather, at the time unwanted environmental effects from GM or other kinds of cropping are identified, Government or a regulator would seem to be best placed to decide what ought to be done, taking account of the impacts of all the different kinds of crop-growing and wider considerations of public policy. Government would also face considerable difficulties in gaining agreement on who should contribute to the costs and may never be able to recover some or all of these, but this is not unique to GM crops, and on balance most of us believe that this administrative liability regime is the most appropriate model for environmental remediation.

359. Government would be expected to make these decisions recognising the environmental policy implications of farmers' responsibility for managing the great majority of the countryside (in addition to producing food), meaning that substantial subsidies are given to support agriculture's delivery of public environmental goods, and other relevant factors. Government ultimately is probably in the best position to make the trade-offs in directing those monies to deliver what society considers the most important environmental goals for the farmland environment. The nature of appropriate action to deliver those goals should not be defined *a priori* now; although that does not imply that it is not important that there is adequate provision to require remediation in future where appropriate.

Recommendation 8: the Environmental Protection Act 1990 should be further amended, reflecting the regime envisaged by the draft Directive. The means of dealing with any environmental effects from the release of GMOs, including diffuse effects, should be the responsibility of the competent regulatory authority, who will have a number of options at their disposal, including requiring remediation.

Other options?

360. We have looked at options for mechanisms that could exist in addition to an amended liability regime, in order to improve the response to possible environmental impacts.

A possible new framework for remediation and all crops

361. We think that the prospect of possible commercial GM crop cultivation could offer an opportunity to set the growing of these crops and the environmental effects of other crops in a new, broader framework.

362. Having found considerable common ground on the principles around an administrative liability regime, the majority of us also favour a more comprehensive model of a single, strong regulatory agency to consider and take action as appropriate in relation to the environmental impacts of GM crops and possibly other crops and other agricultural environmental impacts. Most of us see this as an important confidence-building measure in relation to possible GM crop

commercialisation, although some of us are sceptical about the need for strengthening this area in respect of GM or indeed other crops and think in particular that setting up a new body with such a wide remit could be disproportionate. However, the role we suggest could be fulfilled by an existing body or bodies – most likely the Environment Agency (England and Wales); the Scottish Environment Protection Agency; and the Environment and Heritage Service (EHS) in Northern Ireland.

363. A new framework of this sort could perhaps tackle two of the main areas of uncertainty highlighted previously, and not addressed in present GM-specific environmental liability legislation. First, significant environmental harm caused by non-GM cropping. This could be tackled through extending the Environmental Protection Act to deal with such cases as well as GMOs; or through other legislation covering specific aspects of agriculture or horticulture. If such provision were made, similar regulatory principles about deciding the extent to which remediation or payment would be required should in principle apply to non-GM crops and horticulture as for GM crops.

364. Second, diffuse environmental impacts that cannot be attributed to one or more parties. In addition to a remediation regime for significant attributable (GM-specific or other) impacts overseen by Government or other regulatory agency, there needs to be a means of dealing with these. One option would be for the comprehensive regulatory agency we favour to be given oversight, at arm's length from Government, of remediation of unattributable environmental impacts (whether involving GM crops or not) as well as for serious attributable impacts.

365. But a decision about what action if any would be appropriate at the time a particular unattributable impact was detected would need to take account of the impacts of all the different kinds of crop-growing and wider considerations of public policy. In cases where harm cannot be attributed, either society will inevitably carry the burden of any remediation if remediation is possible at all or, more likely, some other mechanism might be found. Possibilities include amending agricultural policy or the conditions for subsidy payments to incentivise less harmful behaviour, or a levy on crop production to pay for action designed to counteract the environmental harm. There would need to be careful consideration about the extent to which decisions and any related powers, such as the raising of levies, could be given to a regulatory agency or should remain with Government as essentially broad matters of public policy.

Environmental duties alongside coexistence protocols

366. As clearly demonstrated by the results of the Farm Scale Evaluations, the way in which a particular crop is used in the field is likely to have significant environmental impacts. Under commercial conditions, environmental harm could arise due either to insufficient knowledge about how the crop should best be managed (and therefore unforeseeable damage), or to mismanagement through a failure to follow established guidelines.

367. We have considered whether coexistence protocols, which would of course be designed to facilitate consumer choice and deal with economic impacts, could play a positive role in facilitating environmental best practice in any commercial growing of GM crops – going beyond measures designed to prevent or mitigate potential relatively negative impacts.

368. The British statutory conservation agencies recognised in their comments to us[275] that "environmental benefits could be delivered through a variety of different farming practices, including 'conventional' farming practices (particularly when using low input regimes, integrated management and/or agri-environmental measures), organic farming and farming using GM crops... Therefore, coexistence protocols should not impact disproportionately on any one of these sectors. Nor should they impose management practices that would damage the ability of farmers to carry out management for biodiversity." The conservation agencies argued that mandatory coexistence protocols should not be tied to voluntary environmental schemes, at least not while resources for such schemes remain relatively limited. They also note that there may be biosafety reasons as well as economic reasons for restricting gene flow from GM oilseed rape and beet.

369. On balance, we think that coexistence protocols need to be set to deal primarily with economic impacts; but we recognise that there could be measures in protocols which lead to negative (or positive) environmental impacts. Again, the Farm Scale Evaluations demonstrate this. The statutory conservation agencies raise the particular point about strict control of volunteers, which they are concerned could lead to increased herbicide use on farmland of conservation value, such as field margins and set-aside. They argue that the impacts of such management should be taken into account when regulatory authorities make decisions on Part C consents, and now that the EU Deliberate Release Directive takes account of indirect environmental effects, this is possible. Any significant environmental impact of coexistence measures would be something that we would hope that post-commercialisation monitoring (see below) would pick up, and the protocols adjusted if significant problems emerged in relation to environmental impacts, subject to achieving successful coexistence.

370. That said, we see merit in Government, the agricultural biotechnology industry and farmers giving active consideration to the possibility of protocols for positive environmental management of the cultivation of GM or other novel crops, were commercial cultivation to go ahead. They should look into whether environmental protocols could be designed to exist alongside co-existence protocols, enhancing long-term biodiversity without impinging unduly on yields. These protocols could go beyond the sort of measures that constitute voluntary environmental schemes, such as Countryside Stewardship, to include very specific issues normally left to the discretion of the farmer but which may still have significant environmental benefits, such as the timing of spraying.

371. A detailed consideration of the potential of environmental protocols is beyond the scope of this report. However, if commercial cultivation of GM crops proceeds, we believe that real efforts need to be made by all involved to make sure they deliver actual environmental benefits. Any commercial production of GM crops must, we are all agreed, go with the grain of the future direction for farming set out in the Curry report and parallel strategies in the devolved territories: connecting farmers to the marketplace and a strong shift in the direction of enhancing the farmland environment. The same goes for conventional novel and existing crops.

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[275] Comments received from the British statutory conservation agencies on the draft AEBC report on coexistence, choice and redress. 15th May 2003

Recommendation 9: Active consideration should be given to the development of protocols for positive environmental management of the cultivation of GM and other crops, to operate alongside coexistence protocols.

Post-commercialisation monitoring

What is needed from monitoring

372. Just as in relation to economic harm from growing GM crops, our presumption has been that it is crucial to do all we can to *prevent* negative environmental impacts. We have heard evidence[276] that the driver for raising environmental standards in other industries employing new technologies, such as nuclear power generation, has been strong regulatory provision coupled with an effective stewardship and inspection regime[277]. We consider that the same basic elements are appropriate here. Our recommendation above for active consideration to be given to environmental protocols to promote good stewardship is aimed at raising standards.

373. As to monitoring and inspection of environmental impacts, the Deliberate Release Directive requires that a company seeking to commercialise a GM crop must submit its proposed monitoring procedures for approval. In our previous report, *Crops on Trial*[278], we said that we considered it crucial for this long-term monitoring programme to be undertaken in a way that was independent of the plant breeding industry and of interest groups, and to be kept under periodic review. We considered that there must also be agreement on how the results of the monitoring would be used – in particular, on how the powers for withdrawing approval if the monitoring revealed adverse effects would be used, and on issues relating to reversibility and product recall. Monitoring could also be used to test the conclusions of the regulatory process itself.

374. Under the Deliberate Release Directive, Part C consent-holders have the primary responsibility for monitoring as part of their post-market monitoring plans. ACRE is producing guidance on the design of post-commercialisation monitoring schemes, directed to applicants seeking consent to release GM crops for commercial production[279]. ACRE's draft guidance draws a distinction between case-specific monitoring, which is directly linked to checking wholly or partly anticipated effects of growing a particular GM crop; and general surveillance designed to look for longer-term effects and any wholly unanticipated consequences of GM crop growing, as a part of general monitoring of environmental changes in agricultural and natural habitats. It notes that consent-holders cannot be expected to undertake the sort of large-scale work that is carried out in the UK by, for example, the Countryside Survey[280]. The ACRE guidance suggests that consent-holders' monitoring plans should "discuss the extent to which it would be appropriate for them to liaise with the output from this sort of research in a way that improves their ability to detect any large-scale and long-term changes in the environment". The aim should be for

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[276] Evidence taking session, liability subgroup, meeting held on 5th November 2002 (R Macrory) http://www2.aebc.gov.uk/aebc/subgroups/liability_meetings_051102_transcript.shtml

[277] Under the Radioactive Substances Act 1993 (Chapter 12).

[278] Paragraphs 48-49.

[279] *Guidance on Best Practice in the Design of Post Market Monitoring Plans in Submissions to the Advisory Committee on Releases to the Environment* , issued as consultation document, 15 May 2003.

[280] See http://www.cs2000.org.uk; and Biological Conservation 108, 183-197.

consent-holders to gather general surveillance data that are compatible with the wider UK and EU monitoring programmes, in addition to case-specific monitoring. We agree that positive efforts to coordinate these monitoring activities would be useful.

375. Existing general surveillance activities (notably the Countryside Survey) should be kept under review to check that they are providing adequate data, in conjunction with general monitoring activities undertaken by via consent-holders, about the longer term and larger scale impacts of growing GM crops and equivalent conventional crops. The emphasis for Government action should be on taking a view of overall monitoring, including auditing consent-holders' monitoring plans and giving consent-holders full access to Government large-scale surveys that offer general surveillance of the UK's landscape and ecology to help the consent-holders fulfil their obligations in respect of GM crops. There would be no point in Government funding duplicatory, case-specific monitoring in parallel with monitoring being undertaken by GM consent-holders. The focus of action should be on ensuring that the sum total of monitoring activities is adequate.

376. Adequate post-commercialisation monitoring along these lines would involve:

- designing an exercise appropriate to address the pertinent questions, and using analysis sufficiently powerful to give meaningful results; the scale of the monitoring scheme should be sufficient - although some of us question the feasibility of designing a monitoring regime that satisfactorily addresses all of the pertinent issues.
- ensuring public confidence in the process, through oversight by ACRE in an open and transparent way, including publication of the results of monitoring.
- a commitment from Government to act upon what was found, through agri-environment subsidies and incentives, through action at European level to vary consent conditions, or in extremis withdrawing consents and requiring environmental remediation.
- providing adequate resources to address these questions at an appropriate scale: given that we propose developing existing research frameworks, the costs should not be prohibitive.

377. We would stress that post-commercialisation monitoring of GM crops should be conducted alongside environmental monitoring of other forms of cropping and non-agricultural areas, and help support environmentally sympathetic farming practices. It must be sufficient in scope and scale, in conjunction with monitoring being undertaken by GM consent-holders, to give the public confidence that any detectable long-term environmental impacts of GM and other crops will be found.

378. In this context, we note that the Farm Scale Evaluations looked at a range of environmental impacts prior to decisions on commercialisation. This major research effort has significantly enhanced our baseline knowledge of farming impacts. But more is needed. There has been only limited research on the environmental impacts of different agricultural systems and there is a considerable amount to study in this

area. A recent literature study for Defra provides pointers for some areas of potential future work[281].

[281] *A Review of Research into the Environmental and Socio-Economic Impacts of Contemporary and Alternative Arable Cropping Systems*, CEH, May 2003. Available at http://www.defra.gov.uk/environment/gm/research/epg-1-5-99.htm

ANNEX A RELEVANT EU LEGISLATION ON COEXISTENCE

Deliberate Release of GMOs

1. The Deliberate Release Directive 2001[282] governs the release of GMOs into the environment. Part C of the Directive provides that approval for commercial cultivation can be refused only on grounds of risks to human health or environmental safety. Once a GM variety has received Part C approval, it is authorised for use throughout the EU, in line with European single market principles, and in general no individual Member State may prohibit, restrict or impede its use (although Article 23 of the Deliberate Release Directive provides that a Member State may provisionally restrict the use and/or sale of a product on its territory where it has justifiable reasons to consider that the product constitutes a risk to human health and the environment).

Labelling of food containing or derived from GMOs

2. EU legislation establishes a threshold for the percentage content of GM material above which foods must be labelled as containing or being produced from a GMO. Under new legislation[283] food will have to be labelled as containing GM material if it has a content of GM elements of 0.9% or more (previously the threshold was 1%). Below that level, it does not have to be labelled, provided that the GM content is of constructs that have been authorised for use in the EU and can be shown to be adventitious and technically unavoidable.

3. There was previously no tolerance threshold for the adventitious presence in food or feed of GM material that has not been authorised in the EU[284]. The new food and feed regulation provides that there should be a threshold of 0.5% for the adventitious or technically unavoidable presence of such "unauthorised" GM material, provided that the material has received a favourable EU scientific risk assessment and the operator can demonstrate that its presence was technically unavoidable. But this threshold can only be enforced where it is possible to test for the presence of the material in question; this may not be the case if the nature of the relevant GM material is not known[285].

4. The new legislation extends the current labelling provisions to all food and feed produced from GMOs, even if they are analytically equivalent to those derived from

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[282] Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EC (OJ L106, 17 April 2001). This Directive came into force on 17 October 2002. It replaces the previous Deliberate Release Directive (Council Directive 90/220/EEC of 23 April 1990 on the deliberate release into the environment of genetically modified organisms (OJ L117, 8 May 1990) as amended by Commission Directives 94/15/EC of 15 April 1994 (OJ L103, 22 April 1994) and 97/35/EC of 18 June 1997 (OJ L169, 27 June 1997)).

[283] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed; and Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning traceability and labelling of genetically modified organisms and traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. The food and feed regulation entered force on 7 November 2003 and applies from 18 April 2004. The labelling and traceability regulation also entered force on 7 November 2003 and will apply 90 days from publication of a system for development and assignment of unique identifiers for GMOs.

[284] This means, for example, that the European market is completely closed to US maize, which might contain (at however low a level) constructs which have not been authorised in the EU.

[285] See Annex B on testing.

non-GM sources (that is to say, even if no DNA or protein of GM origin is detectable in the final product). It is argued that this responds to the need to enable consumers to exercise choice. It would be achieved through an effective traceability system, under which each operator in the production and distribution chain would have to transmit to the next operator information that a product consisted of, contained or (in the case of food or feed) was produced from GMOs. The regulations were approved by the European Council and Parliament despite concerns on the part of the UK Government and some others about whether some aspects of the regulations can be effectively enforced, particularly for highly-refined products such as vegetable oils where the presence of DNA cannot be detected in the final product, and about the cost of implementing the proposals.

Coexistence

5. A legal basis for Member States to take national measures to promote coexistence of organic and conventional crops with GM crops was introduced during the second reading in the European Parliament of the food and feed and traceability and labelling regulations: "Member States may take appropriate measures to avoid the unintended presence of GMOs in other products."[286] This legal provision takes the form of an amendment to EC/2001/18[287]. Member States may decide to use either existing or new national legislation to put regulation in place at the national level. The European Commission also published guidelines in 2003 "for the development of national strategies and best practices to ensure the coexistence of genetically modified crops with conventional and organic farming"[288]

Seed

6. The issue of adventitious presence of GM elements in seed was highlighted in spring 2000, when seed from the USA and Canada imported as non-GM was found to contain some GM material[289]. Consequently, interim action was brought in by the European Commission to monitor and test seed.

7. There are draft proposals to establish legally enforceable standards for GM content in seed described as non-GM[290]. Briefly, the limits proposed are:

- 0.3% for seed of oilseed rape;
- 0.5% for seed of beet, maize, potatoes, cotton, tomato and chicory;
- 0.7% for seed of soya beans.

These proposed limits reflect the fact that the higher the likelihood of cross-pollination and/or volunteers, the lower the proposed limits have to be to attempt to ensure that the final crop will remain below the statutory threshold. They were designed with the aim that crops produced from these seeds would meet the previous threshold of 1% of adventitious presence, but the European Commission's advice is that they contain a safety margin sufficient to be appropriate also for the new threshold of 0.9%.

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[286] Article 44(2) of Regulation (EC) No 1829/2003 (Food and Feed Regulation).

[287] This change to EC/2001/18 will not require changes to existing national legislation transposing the Directive because the amendment does not impose new duties but rather gives permission to introduce new arrangements on coexistence, at Member State level.

[288] Commission Recommendation of 23 July 2003 notified under document number C(2003) 2624.

[289] For further details, see *Crops on Trial* p37.

[290] SANCO/1542/02July2002, on which Defra consulted interested parties in August 2002.

Organic agriculture

8. The main legal provisions relating to organic agriculture are contained in an EU Regulation that originated in 1991[291]. The original Regulation made only limited provision in respect of GMOs, prohibiting the use of genetically modified micro-organisms for biological pest control. However, an amending Regulation in 1999 goes much further[292]. Its introductory paragraphs record that "genetically modified organisms (GMOs) and products derived therefrom are not compatible with the organic production method; in order to maintain consumer confidence in organic production, genetically modified organisms[293], parts thereof and products derived therefrom should not be used in products labelled as from organic production". The Regulation bans the use[294] of GMOs and their derivatives altogether in organic farming, with the exception of veterinary medicinal products[295].

9. Although European law bans the *use* of GMOs in organic production, it does not at present directly prohibit the *marketing* of organic produce containing GM material at any level[296]. The legislation contains provision for the introduction of a "*de minimis* threshold for unavoidable contamination which shall not be exceeded"[297]. But as the coexistence guidelines published by the European Commission notes, no such threshold has yet been agreed, and there is no current proposal to provide for one.

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[291] Council Regulation No 2092/91 on organic production of agricultural products and indications thereto on agricultural products and foodstuffs ((OJ L 198, 22.7.1991, p. 1: to date amended by 22 later Regulations).

[292] Council Regulation (EC) No 1804/1999 of 19 July 1999 supplementing Regulation (EEC) No 2092/91 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs to include livestock production (OJ L 222, 24.8.1999, p. 1)

[293] Defined in terms of the Deliberate Release Directive.

[294] "Use" of GMOs and GMO derivatives is defined as meaning "... use thereof as foodstuffs, food ingredients (including additives and flavourings), processing aids (including extraction solvents), feedingstuffs, compound feedingstuffs, feed materials, feed additives, processing aids for feedingstuffs, certain products used in animal nutrition (under Directive 82/471/EEC) ..., plant protection products, veterinary medicinal products, fertilisers, soil conditioners, seeds, vegetative reproductive material and livestock".

[295] Article 13, inserting new Article 6(1)(d). Tthe Regulation also specifies that the organic production method implied that for seeds and vegetative reproductive material, the mother plant in the case of seeds and the parent plant(s) in the case of vegetative propagating material must have been produced without the use of GMOs and/or any products derived from such organisms, for at least one generation or, in the case of perennial crops, two growing seasons.

[296] Though produce sold as organic would of course be subject to the normal product labelling regulations.

[297] By a new Article 13 inserted into the original 1991 Regulation by the 1999 Regulation, allowing for the adoption of implementation measures under a special procedure prescribed by Article 14.

ANNEX B TESTING FOR GM CONTENT

Why does testing matter?

1. Food labelling legislation is currently based on defined thresholds for the level of adventitious presence of GM material. So reliable and reproducible testing for the presence of GM constructs will be crucial to any proposed protocol for coexistence, to make it possible to check whether adventitious presence has remained below the threshold as crops leave the farm. When the new traceability legislation (see Annex A) comes into operation, testing will be complemented by a system of Identity Preservation (IP).

Testing methods

2. There are two basic approaches to the testing of plants and seeds: Phenotypic and genotypic testing.

Phenotypic testing

3. Phenotypic testing relies upon the visual inspection of plants and seeds for specific physical characteristics. This method of testing uses differences in plant morphology based on their genetic make-up as a practical system to differentiate plant varieties. It is currently the method employed by producers of certified seed to establish seed purity.

4. A retrospective molecular analysis by the National Institute of Agricultural Botany (NIAB) of certified seed samples which had been subject to phenotypic testing over the past five years showed that the phenotypic testing failed to show the presence of genetic changes in only 0.23% of cases[298]. This shows that phenotypic testing *can* reliably be used to predict gene flow and suggests that the separation distances used in maintaining the purity standards in certified seed production are robust; and consequently that they probably form a reasonable basis (subject to consideration of other factors contributing to adventitious presence) for setting separation distances for GM crop production. It should be noted, however, that phenotypic testing cannot identify the complete genetic sequences in the germplasm. It is of limited use for testing GM varieties where in most cases there is no difference in physical characteristics between the GM and equivalent conventional varieties.

Genotypic testing

5. Genotypic testing involves analysing at the molecular level.

6. One approach depends on detection of the protein produced by the GM construct in the plant. Two tests use this approach:

- the simpler one is the immunochromatographic strip test. It can be carried out on the farm, takes about 20 minutes to obtain an answer, and can be performed by relatively inexperienced personnel[299]. It costs about £5 per sample. But it is not a

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[298] We understand from Defra that NIAB tested 867 non GM samples from the past 5 years, only two of which failed to express a genetic change phenotypically.

[299] The test uses lateral flow test strips which employ antibodies specific to the GM protein which are coupled to a colour reagent. When the test strip is placed in a small amount of an extract from plant tissue that contains

quantitative test: it shows only whether or not the known construct being tested for is present. So a positive result would not show whether a given threshold had been breached: for that further molecular testing in the laboratory would be necessary.

- the other one, the Enzyme Linked Immunosorbant Assay (ELISA) takes a few hours to complete, costs between £10 and £20 and does give a quantitative result. Protein based tests are of limited use, because the protein produced by the GM construct may not always be present in a particular tissue in the plant, or may be present only at a particular point in the plant's lifecycle. And testing for a protein will not discriminate between different plant varieties containing the same GM protein.

7. Both these protein methods work on the same principle – the use of an antibody to detect a protein not normally expressed in the plant, for example the Cry family of proteins used to confer insect resistance. The test can be formulated as a dipstick test for use in field applications or as a laboratory based ELISA. The disadvantages of these tests apart from those already mentioned are first, that they do not discriminate between different constructs carrying the same gene (e.g. the Cry gene); and second, that there can be cross-reactivity between antibodies raised to different forms of a gene (e.g. the Cry protein).

8. This second, more reliable, approach makes use of the Polymerase Chain Reaction (PCR). This molecular technique has to be performed in the laboratory. It uses molecular biology technology to amplify tiny quantities of DNA, which can then be tested to give a quantitative result for the presence of a known GM construct. The advantage of using this molecular test is that it is based on the gene (DNA), which is always present in the plant, and not on the protein produced by the expression of the gene. Generally all parts of the plant can be sampled for PCR testing, although problems may occur with DNA extraction from some tissues. The use of controls in the PCR reaction helps to prevent any false negatives. The disadvantage of the PCR technique is that it can take longer than the other tests (the quoted turn-around time for testing at Central Science Laboratories (CSL) is 10 days, although results are normally made available within five days; a 48 hour service is available for urgent samples, at around twice the normal cost). And it is usually more expensive. The cost of PCR testing at CSL (2003 cost per test) is: oilseed rape £210; maize £210; beet £190. For ELISA and PCR the material to be tested will need to be prepared and extracted for analysis

9. Further research into methodologies, particularly direct detection and fast screening methods, may improve the effectiveness of testing.

The availability of effective testing

GMO protein, binding occurs between the coupled antibody and the protein, thereby giving rise to a colour change. Testing is qualitative and the kits are only available for detecting a limited number of GM lines, such as Roundup Ready (RuR) soya and Bt maize. The manufacturers claim that the test kits can be used for "rapid field testing" to determine the presence of GM inserts in grain, although it should be noted that the extraction procedure requires that the sample is mixed and ground using a food blender or equivalent. Once this has been carried out water is added and the mixture is shaken. The extract is then added to a reaction tube and the lateral flow test strip is inserted. The result can be read in 5 to 15 minutes, depending on the type of test, with a positive result showing up as a clearly defined coloured line on the test strip. The detection limit of these tests varies from 1 GM seed in 1000 (0.1%) for RuR soya, to 1 GM seed in 70 for Liberty Link maize.

10. The effectiveness of testing depends in part upon the proficiency of individual laboratories. A laboratory's performance tends to improve with experience and participation in proficiency testing is mandatory for accredited bodies[300]. In the UK the analytical standard for general laboratories is set by the United Kingdom Accreditation Service (UKAS). Several sets of Committees (The Food and Agriculture Organisation of the World Health Organisation and CEN – the European Committee for Standardisation) are working towards harmonised protocols for GM testing methodology as it would be useful if there were an internationally agreed standard, but development of this has only just started. JRC ISPRA has, through its leadership of the ENGL network taken on the role of the Central Reference Laboratory (CRL) for the EU and therefore takes the lead in the validations of methods submitted by companies wishing to licence products under the EU Directive 2001/18.

11. At present, there is not enough laboratory capacity to meet the demand for testing which could arise if large areas of GM crops were grown, particularly when dealing with large peaks in demand for testing (in particular for oilseed rape, where the time between seeding and harvest is only about two weeks). But if commercial cultivation of GM crops increased gradually in the UK, laboratory capacity should be able to increase in line with demand.

Unknown constructs

12. Testing can only identify known DNA sequences but GM constructs may be unknown[301], although because laboratories conduct their analyses using a combination of commonly used promoter and other sequences such as antibiotic markers and fertility factors, the unknown constructs may still be *detected* (but not *identified*). The GM Inspectorate issues a series of guidelines on which combination of these constructs are appropriate to utilise for a particular crop. This guidance is based on information gathered form dedicated databases and official information on known constructs used in crop material commercially released around the world and in experimental releases.

13. Approved GM crops have gone through statutory regulatory assessment; the regulatory authorities therefore know the appropriate molecular data, so precise PCR molecular analysis for adventitious presence is possible. However there are other classes of GM material where the same extent of molecular information may not be readily available. These are as follows:

(a) *A GM crop that is in the process of regulatory approval for commercial cultivation in the EU*. This does not present a problem for testing; the regulatory authorities know the detailed molecular information, so PCR analysis can be carried out if adventitious presence is suspected. The EU has set a threshold for food labelling of 0.5% in this case, which means that any food product from a seed sample containing over 0.5% of GM crop material in this category must be labelled as containing GM material[302].

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[300] EC93/99.

[301] Because the choice of primer used to amplify the DNA depends on the sequence.

[302] This 0.5% level may also be applicable to crops under legislative consideration in other countries.

(b) *Plant material released under Part B experimental regulatory approval.* This should not present a problem for testing, because there is usually sufficient molecular information available to the regulatory authorities to facilitate PCR analysis of gene flow if that is considered necessary. No acceptable threshold of adventitious presence of a Part B GM construct in a non-GM crop has been established, although depending on the case-by-case risk assessment the regulators often require that gene flow be minimised (e.g. by isolation barriers, or by requiring that sexually compatible species be planted to flower at different times).

(c) *GM material that has not been through the EU regulatory process, which could be present in seeds multiplied in another non-EU country due to adventitious cross-pollination or seed mixing*[303]. Here the EU/UK regulatory authorities may have insufficient molecular knowledge (i.e. knowledge of the DNA sequence of transgene inserts) to make PCR analysis feasible. It has been suggested that an analysis of this kind could focus on common transgene sequences[304], but these sequences are not present in all transgene constructs; they are also common DNA sequences in nature, so false positives may occur, although it should be noted that the possibility of a false positive can often be refuted by carrying out further specific tests. It is proposed that there will be an international register (under the Cartagena protocol) of transgene DNA sequences to facilitate detection of the adventitious presence of GMs of this kind.

14. The screening procedure detailed in the GM Inspectorate guidance is designed to ensure that the widest range of possible GM lines is covered, so that new or previously undocumented GM lines can be identified. Where the construct is well characterised (as in the case of Roundup Ready soya, for example) the use of crossover primers[305] can be employed.

15. Meanwhile, NIAB is proposing a technology that would insert a genetic "barcode" (a particular sequence of DNA, which itself has no biological function) into each construct, so that it could be readily identified as carrying a transgene. All testing laboratories would have access to a catalogue of these to enable them to identify the construct present. Detection could be carried out in crops and foodstuffs as long as the DNA had not been denatured. It would also make any detection in wild populations easier and help with traceability. But as the number of constructs increases, so will the cost of testing for all of them.

Sample size

16. Sample sizes vary depending on the question the test is intended to answer[306]. To test for GM presence in just a few plants (e.g. suspected transgenic volunteer oilseed rape plants), only a few leaves may be needed for testing. On the other

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[303] Seeds are frequently multiplied abroad because it makes it possible to obtain more than one generation of seeds per year: some organic maize seed, for example, is multiplied in North America although the risk of adventitious presence in the US is leading some seed producers to source organic maize seed production from within Europe.

[304] e.g. 35S promotor.

[305] e.g. EPSPS/NOS.

[306] We understand that the Home Grown Cereals Authority is undertaking a review of sampling techniques covering a broad range of subjects, the results of which are due to be published in September 2003.

hand, checking for GM presence in a crop requires as many as 6000 leaf samples for a statistically valid result. The minimum sample size is just a few grams, although the state of the material is important, with fresh green leaves being most suitable for DNA extraction, seeds also suitable, and necrotic or woody material being less suitable.

Accuracy and limits to testing

17. It has been agreed by the EU Scientific Committee on Plants that PCR testing in laboratories can reliably detect a level of 0.1% for known GM events in crops and food, but it is generally agreed that this is the limit of reliable detection in practice[307]. Because this is important in relation to the interpretation of the "GM-free" aspirations of organic bodies, we have looked at the reasons in more detail.

18. Accurate PCR amplification depends on the identification of specific short stretches of DNA. If the experimental conditions are not sufficiently optimised non-GM DNA sequences with similarity to the GM DNA targeted may be amplified. Alternatively the reaction may fail to amplify DNA of any origin. And it is not possible to eliminate sampling errors completely.

19. Theoretically, a single copy of the target sequence (the transgene, or piece of inserted DNA) can be detected by PCR. However, depending upon the primers used (i.e. the reagents used in the PCR reaction) and the size of the target sequence, in practice as many as ten copies may be needed. So although testing can be accurate to a very low level, it cannot give certainty of zero presence. The level of potential accuracy varies from species to species, mainly because the amount of DNA present in the genomes of different species varies. It can be calculated to be around 0.003% for maize and 0.001% for oilseed rape.

20. If a sample is taken that is perfectly representative of a particular crop, there are at least two stages during the analysis where predictable errors may occur.

21. The first stage of error is in taking the sample of seeds from the crop. The binomial distribution in the table below[308] can be used to calculate the size of the sampling error from this source.

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[307] Meaning the lowest level which can be detected without taking impracticably large and costly samples, because extra binomial variation greatly increases the uncertainty at these low levels.

[308] Taken from http://biotech.jrc.it/doc/EuroReport_sampling_strategies.pdf, which also contains further details on these issues.

Sample size	Limit of GM detection (as %) with certainty of:		
	90%	95%	99%
100	2.28	2.95	4.50
200	1.14	1.49	2.28
300	0.76	0.99	1.52
400	0.57	0.75	1.14
800	0.29	0.37	0.57
1200	0.19	0.25	0.38
2000	0.12	0.15	0.23
2500	0.09	0.12	0.18
3000	0.08	0.10	0.15
6000	0.04	0.05	0.08
10000	0.02	0.03	0.05

22. This table shows, for example, that if no transgenic material is detected in a sample of 100 seeds, there is 95% certainty that levels of transgenic material are below 2.95%. A sample of 400 seeds would provide 95% certainty that levels are below 0.75%, and so on. A sample of 3000 would be required to give 95% certainty of levels being below 0.1%.

23. The figures in this table are based on the assumption that all DNA from the stated number of seeds has been sampled for analysis. If this is not the case, a second stage of error is introduced, and the degree of confidence in the results will be lower (though still calculable).

24. However, in practice, other sources of error that cannot be calculated will enhance the uncertainty of achieving these thresholds with the stated level of confidence. The main source of such error is in taking the sample of seeds from the crop. To achieve the levels shown in the table, the sample would need to be perfectly representative of the particular crop. This relies on perfectly even distribution in the crop and is extremely unlikely in practice, because any adventitious material is likely to be unevenly distributed. For example, if adventitious presence arises from cross-pollination, transgenic material may be present on one side of the field and not another. If it arises from inadequate cleaning of farm machinery, the transgenic seeds will not be evenly distributed through the load and hence across the field. If it arises from volunteers, they are unlikely to be distributed evenly through the field. This will both make the sampling error larger, and make it impossible to calculate its magnitude. This is particularly likely to present problems for samples taken at the farm gate: by the time crops have been processed, products may be more thoroughly mixed, and therefore this extra source of sampling error may be minimised.

25. This suggests that:

- sampling error imposes much greater constraints in the limits of detection than the PCR reaction; it follows that the accuracy of detection will not improve with

technological improvement, because sampling errors depend upon probabilities and statistical realities which will not change with time.

- the sample size needed depends on the threshold which it is sought to achieve, and the desired level of certainty of achieving that threshold.
- imperfect mixing will introduce additional unknown and unpredictable sources of error.

26. Because of all these factors, reliable testing to the 0.1% threshold may never be achievable at the farm gate.

Testing for seed production

27. GM testing of seed requires a forensic capability in GM testing[309], as well as detailed information of the sequence of the nucleic acid in the construct used.

28. For PCR seed testing, the GM Inspectorate issues guidelines to importers and producers of conventional oilseed rape, maize, beet and soya seed which specify that the minimum working sample for analysis should contain no less than 3000 seeds. This sample size is in accordance with the proposed protocol submitted to the EC Standing Committee on Seeds in 2001 and is designed to give a 95% confidence level at a 0.1% detection limit. This poses no problem for crops such as oilseed rape but would be expensive and unmanageable and hence impracticable for a potato seed crop.

[309] For example, we were told of a case where seed testing had found elements associated with the presence of GM constructs that are also known to be naturally present in soil borne organisms in the absence of transgenes. This had suggested the presence of transgenes, when in fact none had been present: it was concluded after extensive testing and consideration by ACRE that the marker genes had probably come from bacterial contamination of seed coats. ACRE opinion August 2001.

ANNEX C CHARACTERISTICS AND CRITICAL CONTROL POINTS FOR THE FSE CROPS

Beet

Areas of beet grown in 2001/2002 season in the UK[310]

	Conventional sugar beet	Conventional fodder beet
England	169,029 ha	5204 ha
Wales	105 ha	325 ha
Scotland	0	402 ha
Northern Ireland	0	Figures not available: thought to be very little if any

Figures for organic sugar/fodder beet for 2001/2002 are unavailable. However, in 2002/2003 518 ha of organic sugar beet were grown.

Altogether, beet accounts for about 4% of the total UK arable crop area. It is mostly grown in Eastern England.

How beet grows

1. Beet is a biennial plant, cultivated for its fleshy taproot which forms in its first year, and is used in the sugar industry (sugar beet) and for animal feed (forage beet). Beet is normally planted between early March and early April, and harvested between October and February.
2. "Bolters" are growth on the plant that leads to flowering if unchecked. The percentage of bolters varies depending on when the crop is sown, weather conditions and the varieties of beet used. If bolters are allowed to flower, both sugar beet and fodder beet can cross by wind pollination with other flowering beet varieties or with their close relative sea beet. It is good practice to remove bolters before the plant produces seed, both because they reduce the yield in the crop plant and to discourage weed beet. As long as this is done effectively, separation distances would not be the most critical control point for adventitious presence in commercial crop production.
3. "Weed beet" is unwanted beet within and between rows of sown beet and other crops. Unlike true beet, weed beet produces seed in one year. Weed beet originates mainly from naturally occurring bolters in commercial beet crops, and from the occurrence in seed of cross-pollination from rogue plants. Once weed beet becomes established it is self-perpetuating and produces on average 2000 seeds per plant in the year. Only about half of this survives, but if even a moderate amount (say 1000 seeds per hectare) is released and

[310] http://www.defra.gov.uk/esg/work_htm/publications/cs/farmstats_web/default.htm

uncontrolled the following year it could lead to some one million weed beet per hectare.

4. So were there to be commercial GM beet production, it would be essential that rogue beet in other crops and other areas around the farm and loading sites were also controlled. A cropping interval of 4 years would help avoid this, although if a field were badly infected with weed beet the grower should widen the rotation to 6 or 7 years, with rigorous control of weed beet being carried out in the intervening period. Not sowing early helps minimise bolters.
5. Not much seed beet is grown in the UK. The separation distance for seed production is set at 600m in current legislation.

Oilseed rape

Areas of oilseed rape grown 2001/2002 in the UK[311]

	Conventional winter oilseed rape	Conventional spring oilseed rape
England	305,770 ha	18,733 ha
Wales	1,051 ha	316 ha
Scotland	26,432 ha	4,469 ha
Northern Ireland	100 ha	

Rape accounts for about 10% of the total UK arable crop area.

How oilseed rape grows

6. Oilseed rape is an annual plant with bright yellow flowers. Pods enclosing small black seeds are harvested when they are as dry as possible (ideally 9% moisture content). Vegetable oils (food grade or industrial use) are extracted from the seeds. After oil extraction, the protein-rich residues are made into oilseed cakes used as animal feed. Oilseed rape is also used as a biofuel and in industrial oils.
7. Winter-sown and spring-sown varieties are grown in the UK. The winter varieties are harvested around late July to mid-August, whilst spring-sown crops are sown in the first half of March and harvested in late August to September. Winter oilseed rape is the more commonly cultivated.
8. Most oilseed rape varieties grown are conventional (open-pollinating) or fully restored hybrids. The percentage of Varietal Associations (seed mixes

[311] A further 72,392 ha of oilseed rape was grown on set aside land (which means that it was grown for non-food use). This oilseed rape is High Erucic Acid Rape (HEAR) or double zero (00) which contains glucosinolate. No organic data are available for 2001/2002 season however, in 2003, a total of around 200-250 ha, mostly spring varieties is thought to have been sown (possibly less – no systematic data available).

containing 80% non-pollen producing plants, VAs) in England is now less than 5% of all varieties grown, and is decreasing. In Scotland the percentage of VAs is slightly higher.

9. Rape suffers from competition with weeds, especially grasses and volunteer cereals from the previous crop, which are significant nitrogen consumers. Broad-leaved weeds can lead to admixture problems in the harvested grain, a quality issue for which the grower is penalised. Some such weeds (e.g. charlock, a related species) contain anti-nutritional factors and are currently difficult to control. Consequently in conventional production herbicide treatments are generally considered essential for both yield and quality reasons[312].
10. Oilseed rape is largely (70%) self-pollinating, but it can also cross-pollinate: insects mainly facilitate this. It can cross-pollinate with other varieties of winter or spring oilseed rape, and to a lesser extent with a few other close relatives, namely wild turnip, charlock, turnip rape and mustard[313]. In field conditions, rape does not readily cross with these other species (the opposite way is more common), but if it does the resultant seed is frequently non-viable[314].
11. Varieties of rape flower at slightly different times, but because of the long flowering period there is considerable overlap between the varieties (so it would be impracticable to regulate on variety alone). However, the bulk of the winter crop has normally completed flowering well before the spring-sown crops.
12. Some oilseed rape seed is grown in the UK.

Maize

Areas of maize grown in 2001/2002 season in the UK[315]

	Conventional fodder maize and grain maize
England	111,321 ha
Wales	8,356 ha
Scotland	Not available
Northern Ireland	1,660 ha

[312] http://www.jouy.inra.fr/index.html.

[313] Gene Flow from Genetically modified crops: Background paper by ACRE: available at http://www.defra.gov.uk/environment/acre/pubs/geneflow.htm.

[314] Defra paper on the Environmental risks of Herbicide Tolerant oilseed rape - a review of the Plant Genetic Systems(PGS) hybrid oilseed rape. Available at http://www.defra.gov.uk/environment/gm/pgs.

[315] No organic data available for 2001/2002 season. However, figures for 2003 indicate circa 500ha of organic fodder maize and very little (if any) grain maize was produced.

Maize accounts for around 2% of the total UK arable crop area.

How maize grows

13. Maize is a tall annual cereal with a large single stem that grows to about 2m in height. Around the world it is cultivated for its seeds, rich in starch, which are used as food for humans and animals and in various industries. The entire plant may be used for animal feed, usually in silage.

14. Although maize is the third-largest crop grown in the world, it is a relatively new crop in the UK, hardly grown 20 years ago. The vast majority of maize grown in the UK is forage maize, used almost entirely for ensiling for animal feed. Due to the development of high capacity, contractor based growing and harvesting machinery systems, the crop has become ever more popular and its high energy value as a fodder feed makes it a good complete diet feed during the winter months[316].

15. Most of the crop is grown in the Midlands and southern England, as it is very dependent on accumulated heat units to reach maturity[317]. In the UK maize is sown in April-May, when soil temperatures have risen sufficiently to allow germination; it is usually harvested in late September-October. The first frosts of the season kill the plant, after which quality rapidly declines.

16. All maize grown in the UK is hybrid, with the seeds purchased each year by farmers. There is no maize seed production in the UK, again because the climate does not allow the seeds to reach full maturity.

17. Maize has male reproductive parts at the top of the plant, and female reproductive parts (that form the cob) halfway up the stem. The plant self-pollinates, but it will also cross-pollinate, with wind being the main vector (though the pollen does not travel especially far). Because maize does not produce nectar, bees rarely visit the plant, and when they collect the pollen they do not spread it to the female reproductive part. Maize is unable to shed seed naturally[318].

18. Maize has no close relatives in Europe, and will therefore not outcross with wild relatives. Volunteers of maize are extremely unlikely to occur since maize is not frost-hardy and will not survive the winter. Risk of cross-pollination with other maize varieties could be reduced through careful crop planning, including the establishment of appropriate separation distances where necessary and possibly planting barrier rows. High seed purity would also be important.

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[316] Lockhart & Wiseman eighth edition; written by Finch, Samuel and Lane (published by Woodhead 2002).
[317] It is because of the relatively cool climate that grain maize is not widely grown in the UK.
[318] Tolstrup et al. Report from the working group on genetically modified crops with conventional and organic crops January 2003 (Denmark)

ANNEX D LIABILITY FOR DAMAGE CAUSED BY GENETICALLY MODIFIED ORGANISMS: THE EXISTING LAW

Introduction

1. This survey is intended to set out the principal ways in which, and the extent to which (if at all), those who cultivate or who otherwise deal in or with genetically modified organisms (GMOs) in the United Kingdom may currently become subject to legal liabilities if the GMOs cause damage to individuals, property or the environment, together with some of the practical issues these give rise to. It is not intended to be an exhaustive account of the current law, but simply to assist non-lawyers considering the adequacy of the present system, and to provide the context for proposals for change.

2. After a consideration of the different types of liability and their limits, the main heads of liability are reviewed. The survey also includes an outline of the current proposal for an EU Directive on liability for environmental damage – though this proposal is by no means exclusively concerned with damage caused by GMOs, the need for at least some harmonisation across the EU on the extent of liability for such damage has been a major force driving its development.

3. Responsibility for environmental matters has been devolved to the Scottish Parliament and the Welsh Assembly (though with certain over-riding powers reserved to the UK Government, in part at least to ensure that EU law is implemented in the devolved jurisdictions), and was also exercised in Northern Ireland by the Administration there until it was recently suspended. A fully comprehensive survey should therefore cover how each of these jurisdictions addresses legal liability. However since they have not as yet developed any liability regimes as regards GMOs that are significantly distinct from that applying in England, the survey should be understood as relating essentially to English law and procedure, and any important differences in the other jurisdictions are indicated where relevant.

Types of Liability

4. There are three categories of liability, depending on the nature of the order that a court (or other appropriate body) may make against a defendant – civil, criminal, and administrative.

Civil liability

5. Civil liability is essentially the liability of a defendant to compensate a claimant (plaintiff) for the damage he has caused to him personally or to his property, in so far as this can be quantified in money terms, provided the damage was reasonably foreseeable and is not too "remote" (as to which see paragraphs 23 to 25 below). Because civil cases are concerned with personal rights, they are not apt to protect broader public interests, such as the unowned environment – criminal and administrative liability regimes must generally be used for this. In cases relating to

GMOs, any civil liability is most likely to be in "tort", i.e. tortious liability, but contractual liability may arise in some circumstances, e.g. under the contractual terms implied on a sale of goods under the Sale of Goods Act 1979 or, perhaps, if the terms of an agricultural tenancy have been breached.

6. The burden of proof in civil proceedings is borne by the claimant and is determined on the balance of probabilities, i.e. if on the evidence it appears more likely than not that the claimant's case is made out, then he is entitled to succeed. This is a vastly different standard from that applying to scientific research, for example, where a proposition such as, say, a suggested link between eating a particular substance and a specific symptom in the eater, would not normally be considered to be adequately substantiated unless the available evidence indicates at least a 95 per cent, or maybe an even higher, probability of that outcome. Even so, where the effect of a substance is to increase the incidence of an existing symptom already present in a population, any individual claimant may find the civil burden of proof insurmountable, due to the difficulty of proving that his symptom was caused by the substance and did not occur naturally.

7. Civil liability is in some circumstances said to be "strict" rather than fault based. Where strict liability applies the defendant will be liable for the consequences of his acts (or omissions) even though he has not been in any way at fault[319]. The law starts from the premise that there are inevitably some risks in ordinary life and that if no-one has acted improperly a loss must lie where it falls; however where a person has injured someone else through his fault, then he should be made to compensate the victim. Strict civil liability is an exception to this, and normally applies where one party is undertaking activities that entail a greater risk of harm to others than usual, when it may be considered right that he should accept all the consequences if the harm in fact materialises, however hard he has tried to avoid this. It may also be imposed in circumstances where one party is better able to assess and bear any risk; for example in contract under the Sale of Goods Act 1979, and in the situations to which the Consumer Protection Act 1987 applies. Liability is also strict in nuisance actions between people with interests in land, where the role of the court is to hold the balance between competing interests, and fault is largely irrelevant.

8. If the "polluter pays" principle is to be fully implemented, the polluter should pay for all the consequences of his actions regardless of whether or not he was at fault. To give effect to this principle therefore, liability should be strict in cases relating to environmental damage – self-evidently where recovery is dependent on fault this will inevitably limit the occasions on which the polluter will be made to pay.

9. It is not essential to wait until damage has been caused before proceeding against a defendant, if it is evident that this will occur if he persists in a course of action that he is not prepared to stop. In such a case, and also where damage has already occurred and it appears that a defendant may repeat or continue whatever caused this damage, a court may grant an injunction against the defendant ordering him not to do whatever is specified in the order – a breach of a court order is a contempt of court and punishable in the same way as a criminal offence, by a fine or, in extreme cases, imprisonment. Nevertheless it is for the claimant to take action in the event of such a breach, and to ask the court to impose sanctions on the

[319] Even so there may be legitimate defences, including, for example, the intervention of a third party and an Act of God.

defaulting defendant. In civil proceedings between private parties, to which the general public interest is at best only incidental, the court will not act on its own initiative. It is moreover not equipped to supervise the detailed performance of its orders, and these are accordingly kept as simple as feasible, and are normally framed as prohibitions and not positive obligations to act.

10. Provided a defendant has adequate assets to pay any likely award of damages, a civil liability regime can of course provide compensation to those he may harm. However it is an inadequate means of preventing harm occurring in the first place, since it will only achieve this if every possible defendant is fully aware of the nature and extent of all the potential damages claims he may face, is willing and able to factor the risk of these into his operations, and does this appropriately at all times. It is simply not realistic to assume this will be so in practice.

11. Under the Limitation Act 1980 civil proceedings must normally be started within 6 years of the relevant cause of action arising – this period is reduced to 3 years in the case of actions for personal injury. Since, for the types of action most likely to be in issue, nuisance and negligence, the cause of action only arises when damage is suffered, it is from the date when this occurs that the period starts running. In personal injury cases this could conceivably be many years after actual exposure to harmful material – the impact of mutagens on a person today may only appear several years into the lives of their children yet unborn.

12. Such extensive latency periods can make even insurance problematic, let alone the factoring of risks into current operations. Not even a wholly responsible potential defendant can know how long to maintain a "claims made" insurance policy (insurers are naturally reluctant to offer "occurrence" based policies, where the risks covered are far from certain), or what extent of cover he should provide for. Moreover, if there is a long delay before the claimant is in a position to start proceedings, the defendant may by then no longer be in existence, and the production of credible evidence by the claimant as to what he consumed years before and exactly when may be practically impossible.

Criminal liability

13. A person will be subject to criminal liability if the sanction for an unlawful act or omission is penal, i.e. a fine or imprisonment. Such a sanction is designed to punish the guilty defendant (and maybe to deter others), but not to provide compensation to anyone who may have been injured as a result of the prohibited act or omission, or otherwise to restore the status quo. The proceeds of fines for criminal offences are (with a few exceptions of no relevance here) paid to the Treasury. Though the courts have a limited power to make compensation orders against convicted defendants, these are normally for relatively small sums – a person who has suffered significant damage would need to take civil proceedings to obtain full recompense.

14. In England and Wales, any person may institute criminal proceedings (except for certain specific offences, where this right has been removed by statute), though they must of course have evidence at the outset sufficient to justify the charge. Getting the necessary evidence can be a major difficulty, but this can be alleviated, at least in environmental cases, by requiring regular monitoring and reporting of licensed activities, coupled with rapid public disclosure of the reports. In practice private prosecutions are quite rare – they are however sometimes used to goad the normal prosecuting authority into being more active, as there is no legally binding obligation

on the authorities to institute criminal proceedings if they do not see fit to do so. In Scotland, however, only the Procurator Fiscal may institute criminal proceedings. Because of the consequences of a conviction for a defendant, the rules of criminal procedure, such as those relating to the production of evidence and the criminal burden of proof ("beyond reasonable doubt"), are significantly more stringent than those applying to civil proceedings.

Administrative liability

15. Unlike the bulk of Continental European countries, where administrative law is a largely self-contained regime distinct from civil and criminal law, and adjudicated in separate administrative law courts, in the UK what is termed "administrative law" is a system of regulatory powers that have been given by statute to a variety of public and other authorities, whose exercise of them is subject to supervision by the civil courts. For present purposes the authorities of most relevance are, in England and Wales, the Environment Agency and, in Scotland, its counterpart the Scottish Environmental Protection Agency, and also the relevant Government minister responsible for environmental matters in the UK, referred to in statutes as "the Secretary for State"[320], who in practice operates through officials of the relevant Government Department[321].

16. The regulatory powers of present relevance include, for example, the consideration by the Secretary for State of risk assessments accompanying applications for the deliberate release of GMOs and the setting of conditions attached to permits for their release (which would otherwise be illegal under Part VI of the Environmental Protection Act 1990), and the supervision by the Environment Agency of activities permitted under Part VI. Typically the powers may include the issue and service of "stop" and "enforcement" notices, coupled with a right of entry on to private property to ensure that the notices are acted on. An enforcement notice is designed to procure compliance with statutory requirements and spells out – necessarily with adequate precision, since otherwise it will be invalid – actions that the person served must and must not take that will bring about compliance with statute. Under some statutes, a person responsible for environmental damage, e.g. land contamination or water pollution, can be required to remediate the damage. Section 120 of the EPA has a somewhat comparable provision in respect of remediable damage resulting from an offence under that Act involving GMOs, enabling a court to impose an order for remediation on a defendant convicted of any of the offences of items (a) to (f) of s.118(1), though such an order can only be made following a conviction, whereas in other regimes successful resort to the criminal law is not a necessary pre-condition. In so far as a polluter becomes liable under an applicable administrative law regime to remediate any pollution he may have caused (see below), then fault will generally not be relevant, strict liability will apply, and the "polluter pays principle" will (so far as the particular environmental damage in issue is concerned) be properly applied.

17. Although the steps that may be ordered in respect of remedial work can be extremely expensive, the costs incurred are not in the nature of a penalty but merely

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[320] There are in fact several senior ministers, all with the rank of Secretary for State, who are in theory interchangeable for the purposes of giving effect to statutes referring to "the Secretary for State".

[321] For the deliberate release of GMOs this is primarily the Department for Environment, Food and Rural Affairs (Defra), but the Department for Trade and Industry (DTI) has responsibility for the contained use of GMOs.

the incidental consequence of remedying a failure to comply with statutory requirements. Administrative law powers generally do not extend to the levying of fines or other penalties, nor to requiring compensation to be paid to third parties for past actions. Regulatory authorities may impose criminal sanctions if their orders are not complied with, but these are reserve powers to punish non-compliance with the orders, not the original act or omission that gave rise to them.

18. Regulatory authorities almost invariably have the power themselves to undertake any action they may require of a person in default, and subsequently to require the defaulter to pay the costs that have been incurred in doing this. Except in emergencies, however, this power tends to be used quite rarely, as if the defaulter proves unable to refund the money spent, for example where a company goes into liquidation, the authority concerned may be left severely out of pocket, a situation most are reluctant to risk.

19. Since regulatory authorities are generally merely entitled to take such enforcement action as in their exclusive discretion they consider appropriate, they have no legal obligation to act against a person in breach of the applicable rules if they consider this inappropriate or unnecessary. However in some cases, as in statutory nuisances and the remediation of contaminated land, they have a positive duty to act if prescribed circumstances arise. In these circumstances, if an authority were to fail to carry out its statutory duty, third parties may take court proceedings to force it to do so[322]. It cannot moreover plead lack of resources as an excuse (unless it is insolvent) – for so long as it has any resources available at all for discretionary expenditure, it must first apply them to meeting its statutory obligations.

20. A concern that is as yet not satisfactorily resolved is how regulatory authorities may be held accountable for their actions. They are responsible to a Government Minister for their conduct but, being separate bodies distinct from government, political intervention is not appropriate for dealing with individual matters. Under some regulatory regimes statutory provision is made for appeals from the decisions of the authorities to a specified forum, which may be a specially constituted body or a branch of the High Court. Generally however there is no appeal system, and so a degree of control is exercised by the courts[323] by way of judicial review of the authorities' decisions. By contrast with an appeal, judicial review is strictly limited to considering the legality of the process leading to the decision in question – the merits of the decision cannot be reconsidered. Judicial review is a relatively cumbersome and expensive process, and is only in principle available to persons who are directly affected by the decision in question. Others, such as environmental NGOs, do not necessarily have *locus standi* or "standing" to initiate a case in the courts unless they have been involved in the proceedings at an earlier stage[324]. This has led to somewhat artificial situations where an individual who is directly affected is encouraged by an environmental NGO to lend his or her name to proceedings which are in practice conducted by the NGO. Under the Åarhus Convention, which the UK has said it intends to implement, environmental NGOs are to have access to the courts as of right, but this is not currently the case.

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[322] *R. v. Carrick D.C., ex p. Shelley and anor*, [1996] Env. L.R. 273.

[323] In fact, for English cases, the Queen's Bench Division of the High Court in London.

[324] The decision of Sedley J. in *R v. Somerset CC, ex p. Dixon* [1997] indicated a more tolerant attitude in this respect but the question of standing still remains discretionary and uncertain.

Damages in tort – general principles

21. Before discussing individual heads of liability it is necessary to understand what an award of damages is intended to achieve and what will be excluded from consideration.

Damages are compensatory

22. The principal function of damages is compensatory: "their function is to put the person whose right has been invaded in the same position as if it had been respected in so far as the award of a sum of money can do so"[325]. It follows that there must be a protectable right, i.e. one that is recognised in law, for example, a right not to suffer personal injury or damage to one's own property. There is no such right that members of the public can, as such, invoke to prevent or rectify adverse impacts on public goods, e.g. wildlife, biodiversity or traditional landscapes, and consequently the normal common law torts are not available for such a purpose.

Damage must be foreseeable

23. A person can only be held liable for reasonably foreseeable damage, namely damage which should have been foreseen by a reasonable person as being something of which there was a real risk, even though the risk would only occur in very exceptional circumstances, or in the most unusual case. However "it is justifiable not to take steps to eliminate a real risk if it is small and the circumstances are such that a reasonable man, careful of the safety of his neighbour, would think it right to neglect it", for example because it would involve considerable and disproportionate expense to eliminate it[326]. In the case of GMOs, there may yet of course prove to be consequences of cultivating and using them that have not so far been foreseen, but given the long standing opposition to them, in the course of which numerous adverse scenarios have been canvassed, it would be surprising if there are in fact many risks of significance that have not at least been "foreseen" – the issue that seems more likely to be in contention is what degree of risk is represented by those that have been identified.

24. For organic farmers and bee-keepers, any uncertainty on whether damage to them from the cultivation of GM crops nearby is foreseeable can of course be removed by making known to any GM farmers in the locality what they are doing and the harm they may suffer. Conversely where a person intending to cultivate GM crops positively alerts his neighbours to this, if any of them who might be affected are able to avoid adverse consequences by operating at a greater distance, then even on the assumption that the GM farmer might ultimately be held liable for any damage he thereby caused, the general obligation to mitigate any damage, where it is reasonably practicable to do so, would at least minimise the amount of damages that may be claimed.

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[325] *Albacruz (Cargo Owners) v. Albazero (Owners),The Albazero*, 1977 A.C. 774 at 841, *per* Ld. Diplock.

[326] See *Overseas Tankship (U.K.) Ltd. v. Miller Steamship Co. Pty. (The Wagon Mound) (No. 2)*, [1967] 1 A.C. 617, at 642-644. Also *Bolton v. Stone*, [1951] A.C. 850, where a cricket ball, hit out of the ground, injured a passer-by. The defendant was held not liable – even though the injury was plainly foreseeable as a theoretical possibility, the risk was so small as to justify its being ignored.

Damage must not be too remote

25. Remoteness of damage applies primarily in breach of contract cases, where the defendant will only be held liable for such damages as may "fairly and reasonably be considered either arising naturally ... from such breach ... or such as may be supposed to have been in the contemplation of the parties at the time they made the contract as the probable result of the breach of it"[327]. There may well be other damage, but if it is beyond these natural and foreseeable consequences it is said to be too "remote", and the person in breach will not be held liable for it. In tort actions for negligence, damage is sometimes also said to be too remote, but the reason for denying liability is quite different. As explained below, a person is only liable in negligence to those to whom he owes a duty of care. Where this is the case, his liability is for all foreseeable damage that is the natural consequence of the negligent act, without limitation. However where a person is outside the class of those to whom a duty of care is owed, even though damage to him may have been entirely foreseeable, the defendant will not be liable for it. Thus in the case of *Weller & Co. v Foot & Mouth Disease Research Institute*[328], the Research Institute allowed some foot and mouth virus to escape, and this resulted in an official closure of two cattle markets in the neighbourhood. However the Institute was held not to be liable for the consequent loss of business by a local auctioneer. An escape of the virus would physically affect animals, but nothing else, and hence the Institute's duty of care was owed only to the owners of cattle. The losses of the auctioneers, though certainly foreseeable, were not the result of any physical harm to any property they owned, so they were outside the Institute's duty of care and could not be recovered.

No liability for "pure" economic loss

26. Except in special cases, unlikely to be of relevance in the context of damage caused by GMOs, damages are not available in negligence actions for "pure" economic loss, but only for losses (pecuniary and non-pecuniary) resulting from harm to persons or property. (In the special cases where pure economic loss is recoverable, the defendant has almost invariably assumed a special relationship of responsibility with the claimant, typically as a provider of professional advice.) What amounts to "harm" may sometimes be itself contentious – for example whether the loss of "organic" status for crops that are perfectly sound and capable of being sold on the open market is actionable harm – but once harm has been established, the defendant is liable for all financial losses naturally flowing from it that are not too remote. For example, where an organic farmer's crop is physically contaminated by GMOs resulting from a neighbour growing GM crops, then he may be able to recover in damages such losses as he suffers from the inability to obtain the organic premium that would otherwise have been available, and maybe even the loss in value of part or all of his farm, if it ceases to be suitable for growing organic produce. (It could be however that the courts will not regard either of these as actionable harm, especially if the extent of GM contamination is low – see the section on private nuisance below.) Conversely, if there has so far been no identifiable contamination, but because of his neighbour's activities the organic farmer must nevertheless incur additional costs in analysing his crops to establish that they are still GM-free, such

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[327] *Hadley v. Baxendale*, (1854) 9 Exch. 341.
[328] [1966] 1 Q.B. 569, [1965] 3 All E.R. 560.

costs are pure economic loss that is regarded as a cost of operating a competitive business, and not recoverable.

27. This approach was followed in a case[329] concerning whether a whelk processor who had suffered losses from a ban on fishing for whelks following oil pollution at sea could claim from a fund established to compensate for "damage caused [in the UK] by contamination resulting from the discharge of oil". The Court of Appeal held that "damage" (which was defined to include "loss") had to be given some limits – though it would not be right, when construing a statutory provision, automatically to adopt the common law approach excluding pure economic loss, there is sound basis for the common law principle. Whereas the whelk fishermen's physical activities were affected by the oil pollution such that they were entitled to recover their losses, the whelk processor suffered "a form of secondary economic loss" that was outside the intended scope of the statute. Had Parliament intended any wider scope it could have been expected to make that explicit. This case makes clear that if any compensation fund were to be set up to cater for damages resulting from GM crops, very careful attention would need to be given to exactly who should be entitled to make claims on it, and who should not.

Insurance

28. Even where liability is established, if the defendant has no, or no sufficient, assets to pay an award of damages, then the successful claimant will merely be an unsecured creditor, and may recover nothing. Hence unless adequate insurance cover is held by all potential defendants, legal liability schemes may prove futile. This has been a stumbling block for many proposals seeking to impose liability for various forms of environmental harm and to make obtaining adequate insurance cover mandatory. With no experience of the levels of damages likely to be awarded and in what circumstances, insurance companies are understandably reluctant to provide satisfactory cover initially, or they will offer to do so only at a cost that the would-be insureds perceive as exorbitant. But unless a liability regime is able to run for some time, insurers cannot properly assess the extent of risk and of potential liability that would enable them to quote proportionate premiums. Even then, if, as is common, insurers offer only "claims made" policies, which provide cover only for claims made during the relevant policy year (or, sometimes, shortly after), rather than "occurrence" based policies that will cover all claims, whenever arising, from any harmful occurrence during the relevant policy year, the problem remains of how to cover the possibly lengthy "tail" of liability that will inevitably persist after the relevant activity has ceased.

29. The difficulty of getting insurers to offer any cover at all can be partially overcome by imposing a cap on an insured's total liability for the consequences of any one incident, as applies in the nuclear industry, and/or by requiring him to hold bonds to a specified value that can be applied to settling any liability that may arise. Where there are several potential claimants, however, this approach requires an acceptable system to be in place for apportioning among all of them a sum that is likely to be insufficient to compensate fully for the harm the defendant has caused them.

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[329] *R. J. Tilbury and Sons (Devon) Ltd. v. International Oil Pollution Compensation Fund 1971* (C.A.), *The Times*, 27 February 2003. The case arose from the foundering of the tanker *Sea Empress* in Milford Haven in 1996, which led to a ban on whelk fishing in the area for 7 months.

Heads of Liability

Private Nuisance

30. The tort of nuisance[330] relates solely to acts or omissions on or under land that affect other neighbouring land. Only those owning property, or rights to it, e.g. a tenant or lessee, may sue in nuisance, and not members of the public at large[331]. A claimant must establish that the defendant's use of his land, or what he is permitting to occur on it, is unreasonable in relation to the claimant's land, and that this has caused, or will cause, foreseeable damage to him. There is no need to prove any fault on the part of the defendant – only whether what has occurred on his land is in the circumstances unreasonable. (The Scots law of nuisance does however require *culpa*, but it seems that in practice this will generally be found where there is an unreasonable use of land.) This can require an essentially political decision by the courts as to what is or is not reasonable in the location in question.

31. The law of nuisance provides little or no scope for the court to strike a balance between competing interests, such as those of organic farmers and those wishing to cultivate GM crops, as it can only decide either that the defendant's use of his land is reasonable or that it is not. Any compromise must come from the parties themselves, or, where feasible, through appropriate legislation. If however the claimant's use of his land is regarded as being a particularly sensitive use, he has no ground for complaint if what the defendant is doing would not interfere with a normal use of the land[332] – he must instead find another location that is adequately free from outside disturbance if he is determined to continue with his special use.

32. A court dealing with a nuisance action will necessarily have regard to evidence on what may be considered to be normal behaviour and what may be considered to be unreasonable. It will almost certainly take into account what is regarded as acceptable by regulatory authorities in setting conditions for consents. While this will not be decisive, the fact that the EU food labelling rules allow an adventitious level of up to 1% (soon to be 0.9%) of GM material in food before it must be labelled as containing GM material, would be relevant evidence in considering whether an organic farmer can complain in law, if the extent to which his crops are contaminated with GM material is significantly less.

33. A claimant must necessarily establish that any GM contamination he complains of has been caused by the particular defendant he has sued. This may not cause any difficulty if there is only a single farmer within many miles of him who has cultivated a GM crop of the type found to constitute the contamination, though even then he will have to able to defeat any allegation that his contamination may have originated from his own seed or unclean equipment used on his land. However if there are two or more farmers growing GM crops in his neighbourhood, then he may

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[330] Though normally referred to simply as "nuisance", "private nuisance" is the correct name, to differentiate the tort from the quite distinct "public nuisance", which is primarily a common law criminal offence designed to maintain public order. References here to nuisance are to be understood as referring to the tort only. The widespread use of statutory forms of regulation has made resort to public nuisance largely unnecessary, and public nuisance prosecutions are now rare.

[331] *Hunter v. Canary Wharf Ltd.*, [1997] A.C. 655.

[332] *Robinson v. Kilvert*, (1889) 41 Ch. D. 88. See also the comment of Buxton LJ. in *R. v. Secretary of State for the Environment, Transport and the Regions, ex p. Watson; Sharpes International Seeds Ltd.*, [1999] Env. L.R. 310.

face an insuperable burden of showing on the balance of probabilities that the particular defendant sued is responsible. He cannot simply sue all possible defendants, with a view to getting an apportionment of liability among them all as joint tortfeasors, unless he can make out a good case against each of them individually.

The Rule in Rylands v. Fletcher[333]

34. Until the case of *Cambridge Water Company v. Eastern Counties Leather plc*[334] there was much uncertainty as to the scope of the action under what is referred to as the Rule in *Rylands v. Fletcher*. The latter case had led to the imposition of strict liability on a person who, for his own purposes, had brought on to his land "anything likely to do mischief if it escapes". It was said at first instance that such a person must keep it in at his peril and be *prima facie* answerable for all the damage which is the natural consequence of its escape. This rule would apply not only to obviously dangerous things such as explosives but also, for example, to cattle, water, sewage etc. It would not be surprising if GM crops were also considered to be of a similar nature. However when the case reached the House of Lords, Lord Cairns not only quoted and fully concurred with the principal statement of the law in the first instance judgment, but also gave his own statement of the law in which he introduced the concepts of "natural" and "non-natural" use of land that led to over a century of legal argument as to what he meant by these expressions. Thus it was later held, again in the House of Lords[335], that "non-natural" use must be "some special use bringing with it increased danger to others, and must not merely be the ordinary use of the land or such a use as is proper for the general benefit of the community". On that test the cultivation of GM crops in accordance with a deliberate release consent may well be said to be a proper use.

35. The Rule in *Rylands v. Fletcher* was reviewed at length in the *Cambridge Water* case. It was held there that it is properly a part of the law of nuisance, and that the same principles as regards foreseeability apply – previously strict liability under the Rule had generally been thought to extend to unforeseeable damage as well. However Lord Goff, in considering the question of "non-natural" use, took a firm line in saying that the storage of a substantial quantity of chemicals (in fact organic solvents used in tanning leather) on industrial premises should be regarded as an almost classic case of non-natural use. He also pointed out that, with strict liability limited to foreseeable damage, the courts no longer need feel under pressure to extend the concept of natural use to circumstances such as in *Cambridge Water* in order to avoid the strict liability consequences. While this decision left it for future cases to work out just what should be regarded as "natural" use, it must at least have made it more likely than before that the cultivation of GM crops on agricultural land would be regarded as a "non-natural" use of that land. If the courts were to hold this, then the farmer responsible would be strictly liable for foreseeable damage caused by their escape, and the question whether that use of his land was reasonable in relation to neighbouring land would not arise.

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[333] (1868) L.R. 3 H.L. 330.
[334] [1994] 2 A.C. 264.
[335] By Lord Moulton in *Rickards v. Lothian*, [1913] A.C. 263 at 280.

Negligence

36. The tort of "negligence" consists of (1) the failure by a person to exercise that care which the circumstances demand[336], either by not doing something that should have been done, or by doing something that should not have been done, or at least not in that way, coupled with (2) foreseeable damage caused by that lack of care (3) to someone to whom the negligent person owes a duty of care. It can apply to a great variety of different situations, and whether what has happened amounts to negligence depends on the facts of each case. An act of negligence may also constitute another tort such as nuisance, a statutory tort, or maybe a breach of contract; in such cases a claimant may sue on all or any of the grounds open to him, as he sees fit. It is thus open to a wider class of claimants than nuisance, and equally, there is a much wider class of potential defendants – a farmer cultivating GM crops may possibly be sued in both negligence and nuisance, but of these only negligence would be available to the same claimant against the person who supplied the farmer with GM seeds, and/or the company that originally produced them.

37. For a defendant to be held liable in negligence he must owe the claimant a duty of care. "There is no such thing as negligence in the abstract; negligence is simply neglect of some care which we are bound by law to exercise towards somebody"[337]. Who that "somebody" is was the subject of the well known statement by Lord Atkin in *Donoghue v. Stevenson*:

> "You must take reasonable care to avoid acts and omissions which you can reasonably foresee would be likely to injure your neighbour. Who, then, in law is my neighbour? The answer seems to be – persons who are so closely and directly affected by my act that I ought reasonably to have them in contemplation as being so affected when I am directing my mind to the acts or omissions which are called in question." [338]

It follows that unless a claimant can establish that the defendant owed *him* a duty of care he will not succeed in negligence. In deciding whether the duty applies the courts look at (1) whether the damage is reasonably foreseeable, (2) whether there is a relationship of proximity (which may be physical, circumstantial, causal or assumed[339]) between the parties, and (3) whether the imposition of a duty would be fair, just and reasonable[340].

38. A public body, such as the Environment Agency or a local authority, is not subject to a duty of care when it takes a decision within the ambit of a statutory discretion granted to it. To fall outside this statutory discretion the decision must be so unreasonable that there has been no real exercise of the discretion conferred on it. Even then, if the decision was taken in the course of a statutory regime with its own system of checks and balances or an appeals procedure, the courts may not think it reasonable to impose a duty of care[341]. A public body will also not normally be held liable for damage caused by a failure to exercise a statutory power[342]. Liability may

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[336] *Vaughan v. Taff Vale Rly Co.*, (1860) 5 H&N 679 at 688.
[337] *Thomas v. Quartermaine*, (1887) 18 Q.B.D. 685 at 694.
[338] [1932] A.C. 562 at 580.
[339] *Sutherland Shire Council v. Heyman*, (1985) 60 A.L.R. 1 at 55-56.
[340] *Caparo Industries plc v. Dickman*, [1990] 2 A.C. 605 at 617-618. See also *Anns v. Merton London Borough Council*, [1978] A.C. 728 at 751-752.
[341] See *X (minors) v. Bedfordshire County Council*, [1995] 2 A.C. 633.
[342] *East Suffolk Rivers Catchment Board v. Kent*, [1941] A.C. 74 at 102.

however arise if (1) it would have been irrational not to have exercised the power in the particular circumstances, and (2) there are exceptional grounds for holding that the statute envisaged compensation being paid to those who suffered loss through failure to exercise the power[343].

39. The standard of care is judged objectively – it is not what can reasonably be expected of the particular defendant, but what might be expected of a person of ordinary prudence, or of ordinary care and skill[344], undertaking the same sort of activity as the defendant. Regard must be had both to the probability of harm and to how serious it might be – assessed by reference to such knowledge as the defendant could reasonably be expected to have had at the material time. The objective test attempts to strike a proper balance between over-apprehension and over-confidence: "A reasonable man does not mean a paragon of circumspection"[345].

40. Sometimes, as in pharmaceutical product liability cases, where highly technical issues are involved and the manufacturer may be the only person in full possession of all facts relating to adverse reactions, a plaintiff pleading negligence by the manufacturer is generally not required to do much more than establish (a) harm to himself, and (b) a plausible causal connection between that harm and the pharmaceutical product. The defendant manufacturer is then in practice obliged to prove that everything that should reasonably have been done was in fact done, i.e. that he was not negligent, so that the burden of proof, which is normally on the claimant, is virtually reversed.

Consumer Protection Act 1987

41. This Act contains two main consumer protection provisions. Firstly, under s.2, if there is a defect in a product that causes damage to a consumer, all of (i) the producer of the product, (ii) anyone who, by putting a name, trade mark or the like on the product, holds himself out to be its producer, and (iii) any importer of the product in the course of business, are civilly liable, jointly and severally, to the consumer. A "defect" for this purpose exists if the safety of the product is not such as persons generally are entitled to expect[346], "safety" being defined as including safety in the context of risks of death or personal injury. Originally agricultural produce that had not undergone an industrial process was expressly excluded from the scope of section 2, but this exclusion was removed by in 2000 for England and Wales and in 2001 for Scotland[347]. A safety case would clearly be made out if the GM produce caused actual physical harm, but it is unlikely that there would be any "defect" for the purposes of this Act where a consumer had merely unwittingly consumed GM produce against his wishes but with no evident ill effect.

42. Other amendments were made in 2000/2001 to the Limitation Act 1980 and to the Prescription and Limitation (Scotland) Act 1973 to provide that no action for damages under any provision of Part 1 of the 1987 Consumer Protection Act may be taken after 10 years from "the relevant time".

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[343] *Stovin v. Wise (Norfolk County Council, third party)*, [1996] A.C. 923 at 953.
[344] *Heaven v. Pender*, (1883) 11Q.B.D. 503.
[345] *A. C. Billings & Sons Ltd. V. Riden*, [1958] A.C. 240 at 255.
[346] s.3.
[347] By the Consumer Protection (Product Liability) (Modification) Order 2000, SI 2000/2771, which applied to England & Wales, and by a corresponding Order for Scotland, SSI 2001/265.

43. Secondly, by s.10 of the 1987 Act all consumer goods must meet what is referred to as "the general safety requirement", and, subject to certain prescribed defences, any person who supplies any consumer goods that do not meet this requirement is guilty of an offence, and liable to a fine and/or up to 6 months imprisonment. Exclusions from the scope of s.10 include, however, "consumer goods being water, food, feeding stuff or fertiliser", and consequently it is unlikely that any harm caused by consumption of material from GM crops will give rise to an offence under this section.

Sale of Goods Act 1979

44. The Sale of Goods Act 1979 implies a variety of terms into every contract for the sale of goods, made under the laws of England and Wales, Scotland or Northern Ireland, where the seller sells the goods in the course of a business. Such terms may be expressly excluded, though by virtue of the Unfair Contract Terms Act 1977, in certain circumstances, depending on who the parties are, their relative bargaining powers, and how any exclusion has been brought about, a purported exclusion of the effect of these Sale of Goods Act implied terms may be ineffective – this applies in particular to an exclusion of liability for death or personal injury. The principal implied term of present relevance is that the goods are of "satisfactory quality"; which includes "fitness for *all* the purposes for which goods of the kind in question are commonly supplied", and "safety"[348]. Accordingly, where a farmer buys GM seeds from a seed producer or supplier, or where a consumer buys a product from a retailer that contains GM material, if what is bought is not of "satisfactory quality", as defined in the Act, and suffers damage as a result, the buyer will normally be able to sue for breach of contract. He will of course have to prove that the damage was caused by the product, which may be problematical for a consumer, but the liability is not dependent on foreseeability of that damage. In other words, liability is strict, so that any risk attaching to the goods is borne by the seller rather than the buyer. Nevertheless, the "privity of contract" rule means that only the person who made the purchase can sue – others, for example members of the buyer's family who consume the goods, cannot. They must therefore make use of the provisions of the Consumer Protection Act 1987, referred to above, or, if they can, sue in negligence.

Patent Liability

45. A patent that is in force in the United Kingdom will be infringed[349] if a person does any of a variety of things in the United Kingdom, such as making, importing, using, selling or supplying, anything within the scope of the patent claims, unless he has been licensed to do so by the patentee, either directly or by implication (e.g. where he is dealing with a product previously put on the market without restriction by the patentee or with his authority). A farmer who grows and sells a GM crop from seeds covered by an existing patent will therefore infringe that patent unless he has bought them from the patentee or a licensee of the patentee[350].

46. In Canada this has resulted in a farmer being held liable for patent infringement, and so subject to damages and an injunction, for growing and selling GM rapeseed that he had collected from his own previous year's crop, even though the original

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[348] Sale of Goods Act 1979, s.14(2), (2A), (2B).

[349] Subject to a number of exceptions of no immediate relevance here.

[350] Save as provided for in the Patents Regulations 2000 (SI 2000/2037), which implement EU directive 98/44/EC, referred to in paragraph 46.

presence of the GM seed on his land was accidental, and from an unknown source[351]. This case[352] is not however authority for regarding all use of accidentally occurring patented GM crops as an infringement. In the case in question a farmer had deliberately saved, and sowed in the following year, seed from a small part of his overall crop that had proved resistant to the glyphosate herbicide Roundup[353]. The injunction restrained the two defendants from (among other things) "planting or growing seeds which *they know or ought to know* contain genes or cells as claimed in [the relevant claims] of the patent". The point was left open what the position would be where a farmer merely sold, or kept for next year's planting, seeds which happened to be contaminated with GM seeds, if he was ignorant of this, but it was indicated that the decision might then quite possibly be different.

47. In the UK, issues of patent infringement are determined in accordance with rules laid down in the European Patent Convention and, for "biotechnological inventions", in EU directive 98/44/EC, and so are quite distinct from the corresponding Canadian law. Nevertheless the broad principles of the two regimes have much in common, and the Canadian litigation is thus of direct relevance. Under directive 98/44/EC, where certain species of GM seed are covered by a patent, farmers may use such patented seed when harvested from their own crop to grow further crops on their own land, provided they pay an "equitable remuneration" to the owner of the patent rights.[354] However this only applies if the original GM seed was sold to the farmer by the patentee, or with the patentee's consent, so would not apply to other GM seed grown accidentally, for whatever reason.

Administrative Liability under the Environmental Protection Act 1990

48. The enforcement of the controls over GMOs contained in Part VI of the EPA is delegated by the Secretary of State to inspectors. Section 115(3) of the EPA sets out an extensive list of the powers that an inspector may exercise, which include rights to enter on to relevant premises, to take samples, and to obtain information (this last is reinforced by additional powers under s.116 to require information to be provided). Section 117 gives an inspector a further power to seize and destroy, or otherwise render harmless, any GMO and anything containing GMOs that he believes to be a cause of imminent danger. The Secretary of State has a general power under s.110 to serve a prohibition notice on anyone proposing to import or acquire, release or market any GMOs, or who is keeping any GMOs, if he is of the opinion that this may involve a risk of causing damage to the environment. This may be done whether or not the person to be served has a consent permitting any act prohibited by the notice.

Criminal Liability under the Environmental Protection Act 1990

49. Section 111(1) of the EPA 1990 states:

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[351] Possibly through wind-drift and/or cross-pollination, though, it seems, more probably accidental spillage by a neighbour.

[352] *Percy Schmeiser et al. v. Monsanto Canada Inc.* reported at (2002) FCA 309 (Canadian Federal Court of Appeal, 4 September 2002). Leave to appeal to the Canadian Supreme Court has been granted, and this further appeal is currently expected to be heard in January 2004.

[353] The uncontradicted evidence however was that he had not used glyphosate herbicide while the plants were growing, and so had not taken advantage of the plants' Roundup resistance.

[354] "Small farmers", as defined for the purposes of IACS, do not have to make this payment.

> "Subject to subsection (7) below[355] no person shall import or acquire, release or market any genetically modified organisms ... except in pursuance of a consent granted by the Secretary of State and in accordance with any limitations and conditions to which the consent is subject."

Section 111(2) similarly prohibits the keeping of GMOs that have been imported or acquired except in pursuance of a consent and in accordance with its terms. Section 118(1) of the EPA 1990 sets out a long list of prohibited acts the doing of which constitutes an offence. In particular under s.118(1)(c) it is an offence for a person

> "to do anything in contravention of section 111(1) or (2) above in relation to something which is, and which he knows or has reason to believe is, a genetically modified organism."

A person guilty of an offence under s.118(1)(c) is liable to a fine and/or 6 months imprisonment on summary conviction (i.e. in England, in the magistrates courts) or an unlimited fine and/or up to five years imprisonment on indictment (i.e. in England, in the Crown courts).

50. If a corporate defendant commits an offence under the EPA with the consent or connivance of any director, manager, secretary or other similar officer of the defendant company, or if the offence was attributable to any neglect on the part of any of them, each such individual will also be guilty of the offence and liable to the same penalties[356]. Further, where the commission of an offence under EPA Part VI (among others – this being the Part relating to GMOs) was due to the act or default of some other person, that other person may be charged with and convicted of the offence as well as or instead of the first person[357].

51. Section 120 of the EPA enables the court dealing with a prosecution under items (a) to (f) of s.118(1) to order a person convicted of any of those offences to take such steps as it may specify for remedying anything that it is in the power of the defendant to remedy. Such an order may be made in lieu of or in addition to any fine or imprisonment that the court might impose.

Directive 2001/18/EC on the Deliberate Release into the Environment of GMOs

52. GMOs may only be deliberately released or "placed on the market" within the EU in accordance with this Directive. "Placing on the market" means making available to third parties, whether in return for payment or free of charge. Article 22 of the Directive states:

> "Without prejudice to Article 23, Member States may not prohibit, restrict or impede the placing on the market of GMOs, as or in products, which comply with the requirements of this Directive."

Article 23 is a "Safeguard Clause", which enables a Member State to take unilateral action and provisionally restrict or prohibit the use and/or sale of a GMO as or in a product on its territory, if, but only if, it has grounds for considering that it represents a risk to human health or the environment as a result of new or additional information

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[355] s.111(7) relates to possible exemptions.
[356] EPA s.157(1).
[357] EPA s.158.

made available since the date of the relevant consent for the release of that GMO. Regulation 32 of the UK Deliberate Release Regulations 2002[358] gives the Secretary of State power to serve a prohibition notice to achieve this.

53. Although authorised GMOs and GMO products must therefore be allowed to be used and to circulate throughout the EU, they nevertheless remain subject to normal liability rules (provided they are non-discriminatory). In particular, Recital 16 of the Directive states in part:

> "The provisions of this Directive should be without prejudice to national legislation in the field of environmental liability, while Community legislation in this field needs to be complemented by rules covering liability for different types of environmental damage in all areas of the European Union."

Recital 8 notes that the precautionary principle has been taken into account in the drafting of the Directive, and adds that it must be taken into account in implementing it.

54. The reservation to the Member States of national rules on environmental liability may perhaps be affected by whatever new environmental liability legislation is eventually issued at EU level, but for the present the UK may enforce its current domestic environmental rules as it sees fit, and create new ones, provided of course they do not offend against the general EU law principle of non-discrimination, whether direct or indirect. Recital 16 is concerned with environmental liability only; other areas of liability can nevertheless continue to be operated as normal as the EU does not seek to interfere with non-discriminatory domestic legislation.

EU Proposals for a Directive on Liability for Environmental Damage

55. The European Commission has been working on proposals for harmonising environmental liability for many years. Their original very wide scope has been refined and restricted over the years to a relatively straightforward regime due to be implemented by a directive on environmental liability. A common position on the draft directive was adopted by the Council of Ministers on 18 September 2003[359]. This will shortly be given a Second Reading by the European Parliament, and further amendments may be made under the Conciliation procedure thereafter. Adoption of the directive is expected by May 2004 at the latest, as the Parliament will then be dissolved and any uncompleted legislation will fall. Member States will have 3 years from when it comes into force – probably therefore until around mid-2007 – to implement it in their domestic laws.

56. The directive is now limited to creating a form of administrative liability enforceable by national "competent authorities" – in the UK these will presumably be the Environment Agency and SEPA. Earlier proposals to create a form of tort (civil) liability as well have been abandoned. Liability under the new scheme will accordingly be essentially to remediate environmental damage (or to cover the costs incurred by the competent authority in doing so), but not to pay damages to third parties. As will be seen, the directive is however only concerned with environmental damage to species and habitats, water pollution, and contamination of land that

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[358] SI 2000 No. 2443.
[359] Under reference '10933/5/03 REV 5'.

creates human health risks. It will not therefore normally apply to adventitious presence of unwanted GM species from neighbouring properties in crops on farming land, nor to cross-fertilisation of GM species with wild relatives, unless these happen to come within or materially affect the protected species and habitats that it does apply to. Nevertheless, the directive permits Member States to set up more stringent regimes, including making it applicable to additional activities and extending more widely the category of potentially liable people.

57. The EU regime will impose liability only for certain restricted categories of environmental damage, namely:

(1) damage to species and natural habitats protected under the EU Habitats and Birds Directives[360], where this has significant adverse effects on reaching or maintaining the favourable ecological status of such species or habitats – Member States may designate additional species and/or habitats if they so wish;

(2) "water damage", i.e. damage that significantly affects the ecological, chemical and/or quantitative status and/or ecological potential of waters subject to the Water Framework Directive 2000/60/EC; and

(3) "land damage", which is any land contamination that creates a significant risk of adverse effects on human health.

58. Liability for any of these types of environmental damage would be strict for activities covered by any one of a lengthy list of EU environmental Directives – these include Directive 2001/18 on the deliberate release of GMOs, and the contained use Directive 90/219 – and also for the transport of GMOs within the scope of Directive 2001/18. For damage to protected species or habitats caused by any other activities, liability would arise only if the operator has been at fault or negligent. Member States would be under a duty to ensure that operators comply with their obligations by requiring them to take restorative measures for any damage for which they are liable. In earlier drafts of the directive, if the operator failed to respond or could not be identified, the Member State would have had to undertake the work itself and (where practicable) recover the costs of doing this from the liable party; this obligation has however now been converted to a mere power to undertake appropriate measures. National provisions would apply for apportioning the restoration costs among two or more liable parties. Member States are required to encourage operators to take out insurance or provide other financial security in respect of their potential liabilities. After 8 years the Commission is to present a report on, inter alia, the availability of suitable insurance, and it may then make proposals for mandatory insurance. A provision calling on the EU Commission to prepare an additional directive expressly dealing with liability for damage caused by GMOs – prompted by a perceived weakening of the effect of the current draft directive – was inserted by the EU Parliament, but it has been removed. Instead, the Commission must submit a report after 10 years covering, inter alia, the application of the directive to GMOs as well as the results of any incidents of environmental damage caused by GMOs.

59. Restoration would have the objective of returning damaged habitats and polluted water to or towards their baseline condition, while contaminated land would have to be remediated sufficiently to remove any significant risk of adverse effects on human health. The relevant authority would select the most suitable restorative option in the

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360 Directive 92/43, [1992] O.J. L20/76 (Habitats); Directive 79/409, [1979] O.J. L103/1 (Birds).

light of a "common framework" of rules set out in an Annex to the directive. These require special regard to be given to, inter alia, the cost of the various options, the likelihood of success, the avoidance of future and collateral damage, and the benefits to the damaged resource and the effects on public health and safety. In some cases the most appropriate option may not be a direct intervention at all, but simply letting nature take its course. Pending full restoration "compensatory remediation" must be undertaken, being improvements to protected natural habitats, species or water, at either the damaged site or elsewhere, aimed at compensating for the interim loss of natural resources and "services"[361] pending recovery. Hence, letting nature take its course would not necessarily be the cheapest option. Where remediation of the site cannot bring it back to its baseline condition, or can do so only at a disproportionate cost, then "complementary remediation" must be undertaken, designed to provide a similar level of natural resources and/or "services" as would have been provided if the damaged site had been returned to its baseline condition. (This provision aims to avoid situations where a person who has ruined a site beyond hope of recovery pays less in restoration costs than someone who has only partially damaged it.) Even so, a competent authority may decide not to pursue remedial measures if those already undertaken have eliminated any significant risk of adverse effects on human health, water, or protected species and natural habitats, and the cost of remediating further towards the baseline condition would be disproportionate to the environmental benefits to be obtained.

60. Environmental NGOs and other organisations "having a sufficient interest in environmental decision making relating to the damage", are to be entitled to require any competent authority responsible for enforcing the liability provisions to carry out its duties, and to have access to a court or other independent body to review the acts or omissions of the authority. (The law in the UK would normally enable this anyway, but this provision ensures that relevant NGOs have the standing to take court proceedings, which can otherwise be uncertain.)

Defences

61. Even where liability is to be strict, certain limited defences are still provided[362], such as wars, "a natural phenomenon of exceptional, inevitable and irresistible character" (i.e. in British parlance, an "Act of God"), intentional acts of third parties provided appropriate safety measures were in place, and compliance with a compulsory order from a public authority. The draft directive as published contained two further defences against strict liability, namely "compliance with statutory consent" and a "state of the art" defence, though neither would apply if the operator had been negligent. There has been much contention over whether to retain these two defences, and though at the time of writing the eventual outcome has yet to be finalised, it is currently as follows. Under Article 8(4) Member States 'may' (so they now have discretion, and therefore need not) relieve an otherwise liable operator of the costs of remediation if he shows both that he was not at fault or negligent and that the environmental damage was caused by either (a) an emission or event expressly authorised by, and in full compliance with, a relevant statutory consent, or (b) an emission or activity or any manner of using a product in the course of an activity, if at the relevant time this was not considered likely to cause environmental

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[361] Defined as the functions performed by a natural resource for the benefit of another natural resource or the public.

[362] See Article 4.

damage according to the then scientific and technical knowledge. What degree of likelihood is intended under (b) is not wholly clear – presumably Member States would only wish to allow this defence (if at all) if the current knowledge indicated either that no emissions etc. were foreseeable or else that such emissions etc. as were foreseeable were of such a nature that there was no reason to suppose that any environmental damage might result from them.

62. The "compliance with statutory consent" defence is based on the argument that the community as a whole requires and benefits from industrial operations. Hence if an operator is in full compliance with all relevant statutory consents, and nonetheless some damage occurs as a result of the operations subject to the consent, then the community should bear the cost of responding to that damage, and not the particular operator who has only done what was considered appropriate by the consenting authority before it gave its consent, and who is therefore in no way at fault. To impose liability on the operator is to discourage industrial activity in the UK and, arguably, to encourage imports. Against this are (1) the long standing argument that statutory consents do not and should not affect the rights of third parties (though this has less force in relation to environmental damage), and (2) the concern that regulatory authorities would themselves be exposed to liability if such a defence were available and that they would consequently be far more restrictive in granting consents at all and anyway in the conditions they attach to them. Unless consents became even more detailed than they often are already, there would frequently be a further problem of determining whether the act or omission that caused the damage was truly part of the consented activity, or whether it was some separate activity for which the consenting authority should not be held responsible.

63. The "state of the art" defence is mainly one of foreseeability. It says that if an operator has done all that he could reasonably do having regard to the state of knowledge at the material time, both in regard to what he is putting on the market and in the precautionary measures he may take in his operations and any after-sales monitoring, then he should not be made liable for unforeseen and unforeseeable damage that it was not practically in his power to prevent. The greater the risk he faces of significant damages claims in such circumstances, the greater the pressure on him not to innovate at all, and that cannot be for the long term benefit of the community. The counter-argument is that even though there may be relative uncertainty, the operator is still in a far better position to assess what risks there may be than those dealing with him or his products, and to obtain suitable insurance, so that it is equitable to make him bear such unknown risks as there may be. Additionally there has been strict liability since 1893, when the Sale of Goods Act was first enacted, and in fact before then, and arguably this does not seem to have affected innovation unduly.

The Cartagena Protocol

64. The Cartagena Protocol, which came into force on 11 September 2003, is a protocol to the Convention on Biological Diversity, which was one of the principal agreements reached at the Rio de Janeiro Conference in 1992. It seeks to enable a degree of control to be exercised over transboundary movements of GMOs "that may have adverse effects on the conservation and sustainable use of biological

diversity, taking also into account risks to human health"[363]. The Protocol nevertheless excludes various categories of GMOs from some of its provisions, and also distinguishes between two categories of relevant GMOs: "LMOs" (Living Modified Organisms) generally[364], and "LMO-FPPs" (Living Modified Organisms intended for direct use as Food or Feed, or for Processing).

65. The central feature of the Protocol is a prior informed consent procedure, whereby importing countries may require information relating to any GMOs intended for use in its territory, in advance of their arrival. There are however numerous exclusions from this procedure, for example, where the LMOs are in transit or intended for contained use, or are LMO-FPPs. Where the procedure applies there must be a full notification of all relevant scientific data by the exporting country, and the importing country must carry out a thorough risk assessment as prescribed in the Protocol on the basis of this information, and any other that is available to it, to establish the risk of any adverse effects of the kind that the Protocol applies to.

66. For LMO-FPPs, a different procedure is provided. In this case, there is a "product-based" information sharing system, in which national authorisations of LMO-FPPs are notified (within 2 weeks of each authorisation) to all other parties to the Protocol through a "Biosafety Clearing House" (the "BCH"). The BCH is also to be given, and to make available to all other parties, copies of relevant national laws and regulations.

67. National authorities are to take decisions on imports of both LMOs intended for release, and of LMO-FPPs, based on the precautionary principle. Accordingly, lack of scientific certainty due to insufficient relevant scientific information and knowledge regarding the extent of potential adverse effects of an LMO need not prevent a proposed importing country from taking a decision with regard to the import in order to avoid or minimise such potential effects.

68. Article 27 of the Protocol provides:

> "the Conference of the Parties ... shall, at its first meeting, adopt a process with respect to the appropriate elaboration of international rules and procedures in the field of liability and redress for damage resulting from transboundary movements of living modified organisms, analysing and taking due account of ongoing processes in international law on these matters, and shall endeavour to complete this process within four years."

In April 2002, the Intergovernmental Committee for the Protocol recommended that at the first meeting of the Parties to the Protocol a group of experts should be set up to implement this Article, and invited comments on the terms of reference for such a group.

69. The EU and the Member states signed the Cartagena Protocol in May 2000, and the Commission has now issued a Regulation[365] intended to implement those aspects of it not adequately covered by existing legislation, namely exports of GMOs

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[363] Trade agreements designed to enable countries to prevent certain types of imports are always liable to conflict with the free trade principles of the World Trade Organisation (the WTO), leading to uncertainty which would prevail in the event of a dispute. However the Cartagena Protocol was produced with the WTO in mind and appears to be largely consistent with it.

[364] [79] The Protocol's definition of LMOs is closely similar to, but not identical with, the definition of GMOs in the EU deliberate release Directive, but the differences are not of significance for present purposes.

[365] [80] COM(2002) 85 final, 18 February 2002.

from the EU. In essence an exporter of a GMO would have to provide the BCH with the same risk assessment information as was provided to enable the GMO to be used or marketed in the EU.

Richard Burnett-Hall

October 2003

ANNEX E OUR SOURCES

A number of letters, papers and other documentation was submitted to the AEBC as evidence in producing this report. Some of these papers have been published or placed on websites; others have not. They may all be viewed by prior arrangement with the AEBC secretariat.

A substantial number of oral contributions were also heard mainly from experts at sub-group and stakeholder meetings. Minutes of the principal meetings, including all the sub-group and stakeholder meetings, can be found on the AEBC website http://www.aebc.gov.uk.

The AEBC also made use of a wide range of publications in taking forward the work on this report. We also received a number of letters and submissions. Citations as appropriate are contained in the footnotes to the main text of this report.

We have listed below our principal evidence-gathering activities

Evidence-taking sessions

1. Liability group meeting with British Society of Plant Breeders, and Elsoms Seeds on 5 December 2001; and 6 December meeting with DETR/ Defra;
2. Liability group meeting with Association of British Insurers on 20 December 2001.
3. Liability group meetings in Brussels on 18 January 2002 with EuropaBio, European Commission, NGOs (Friends of the Earth Europe, Association of European Consumers, European Environmental Bureau, World Wildlife Fund, Greenpeace EU unit) and with UKREP.
4. Liability group meeting with NFU Mutual on 28 February 2002.
5. Liability group meeting with David Howarth, University of Cambridge on 19 March 2002.
6. Liability group meeting on 25 April 2002 with agricultural biotechnology council (abc) representatives.
7. AEBC meeting Edinburgh 12 September 2002 – evidence taking session for coexistence. Speakers - Professor Joe Perry (Rothamstead Research Centre) and Dr. Mike Wilkins (University of Reading)
8. Consumer Choice and coexistence group technical workshop held at Central Science Laboratories (CSL), York on 19 September 2002
9. Liability group meeting in public on 5 November 2002: note and transcript. Evidence from Professor Richard Macrory, Stephen Tromans, Phil Michaels (Friends of the Earth), Claire Marris, Peter Melchett, (Soil Association), Archie Montgomery and David Hill (National Farmers Union).
10. Liability group seminar with stakeholders on 8 April 2003.
11. Consumer choice and coexistence group seminar with stakeholders on 28 April 2003

Liability scenarios consultation

12. Responses to the 30 September 2002 liability scenarios consultation. (summarised in AEBC paper AEBC/02/17 Annex A) http://www2.aebc.gov.uk/aebc/about/papers/aebc0217annexa.htm

Informal briefings and submissions from witnesses

13. Professor Joe Perry - Rothamstead Research Institute
14. Dr. Jeremy Sweet – NIAB
15. Dr. Jan Ingram – formerly of NIAB
16. Nick Downey - National Association of Agricultural Contractors.
17. The Soil Association
18. Organic Farmers and Growers
19. Central Science Laboratories
20. Defra, Food Standards Agency and devolved administration officials
21. Prime Minister's Strategy Unit
22. The Science Review Panel
23. Home Grown Cereals Authority
24. Pesticides Safety Directorate
25. Friends of the Earth
26. Greenpeace
27. British Retail Consortium
28. Supply Chain Initiative on Modified Agricultural crops (SCIMAC)
29. Tony Pexton - the assured combinable crops scheme
30. National Farmers' Union
31. English Nature
32. British Society of Plant Breeders

ANNEX F WHO WE ARE

History

The need for independent strategic advice on developments in biotechnology and their implications for agriculture and the environment emerged from the Government's review in 1999 of the advisory and regulatory framework for biotechnology[366]. The main concerns expressed during wide consultation were that the current arrangements were complex and difficult for the public to understand, did not properly reflect the broader ethical and environmental questions and views of potential stakeholders, and were not sufficiently forward-looking for a technology which was developing so rapidly.

Government concluded that the existing regulatory and advisory committees should continue to consider whether to grant approvals for individual products or processes, in the context of protecting the health of the public and protecting the environment. But there was also a need for a strategic framework for the overall development of the technology in the UK, to reflect the broader ethical and environmental concerns of society and to consider the future implications of biotechnological developments. The Agriculture and Environment Biotechnology Commission was set up to help provide this.

Terms of reference

The Commission's terms of reference state that it will:

- offer strategic advice to Government on biotechnology issues which impact on agriculture and the environment;
- liaise closely with but not duplicate the work of the other two bodies which together with the AEBC form a new strategic advisory framework i.e.:
- the Human Genetics Commission (HGC) which will advise on genetic technologies and their impact on humans; and
- the Food Standards Agency (FSA) which will include within its responsibilities all aspects of the safety and use of genetically modified food and animal feed;
- keep under review current and possible future developments in biotechnology with actual or potential implications for agriculture and the environment;
- advise Government on the ethical and social implications arising from these developments and their public acceptability; and
- consider and advise on any specific issues relating to relevant aspects of biotechnology as requested by the Government.

As part of this process the Commission is expected to:

- identify any gaps in the regulatory and advisory framework;

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[366] Cabinet Office, Office of Science and Technology, *The Advisory and Regulatory Framework for Biotechnology: Report from the Government's Review*, May 1999.

- consider the wider implications of the lessons to be learned from individual cases requiring regulatory decision;
- advise on any changes which should be made to Government guidelines which regulatory bodies are required to follow;
- make recommendations as to changes in the current structure of regulatory and advisory bodies;
- co-ordinate and exchange information with the relevant regulatory and advisory bodies;
- seek to involve and consult stakeholders and the public on a regular basis on the issues which it is considering; and
- operate in accordance with best practice for public bodies with regard to openness, transparency, accessibility, timeliness and exchange of information.

The Commission will:

- in carrying out its work take into account European and global developments;
- nationally, adopt a UK perspective taking appropriate account of legal and other differences between England, Scotland, Wales and Northern Ireland; and
- draw up a work programme.

The Government may also ask the Commission for advice on a particular issue and, if necessary, direct it not to become involved in an area if this could be better handled elsewhere.

NOTE: In the context of the work of the Commission, "Government" comprises the UK Government and the devolved administrations.

This report is agreed by the Commission as a whole. Work on it was undertaken in the liability subgroup (whose members are denoted below by *) and consumer choice and coexistence sub-group (members denoted by **).

Chair
Professor Malcolm Grant CBE *
Provost and President, University College London

Deputy chair
Ms Julie Hill MBE **
Programme Adviser and former Director of Green Alliance

Members

Ms Anna Bradley (**until August 2002 only)
Consumer Affairs Director of the Financial Services Authority

Ms Helen Browning OBE **
Tenant Farmer, Eastbrook Farm; Founder and Director of Eastbrook Farm Organic Meats Ltd

Dr David Buckeridge
Business Director of Advanta Seeds, responsible for European and North American operations

Dr David Carmichael **
Arable farmer with an interest in non-food crops

Professor Philip Dale *
Leader of the Genetic Modification and Biosafety Research Group at the John Innes Centre, Norwich

Dr Ed Dart CBE
Chairman of Plant Bioscience Ltd

Dr Matthew Freeman *
Senior Researcher at the Medical Research Council Laboratory of Molecular Biology

Mr John Gilliland *
President of the Ulster Farmers Union and arable farmer with a particular interest in sustainable production systems and the pioneering of non-food crops

Professor Robin Grove-White
Professor of Environment & Society, and Director of the Centre for the Study of Environmental Change, Lancaster University

Dr Rosemary Hails MBE (Convenor of consumer choice subgroup from mid-March 2003) **

Ecologist, and Principal Scientific Officer, Centre for Ecology and Hydrology Oxford and lecturer at St Anne's College, Oxford

Ms Judith Hann
A Freelance broadcaster and writer who presented Tomorrow's World for 20 years

Ms Chi Chi Iweajunwa
Member of executive evaluation group for NHS Direct, and member of Partners Council for NICE (National Institute for Clinical Excellence)

Dr Derek Langslow CBE *
Scientist specialising in nature conservation/biodiversity and former Chief Executive of English Nature

Professor Jeff Maxwell OBE **
Former Director, Macaulay Land Use Research Institute

Dr Sue Mayer * (and ** until August 2002 only)
Executive Director of Genewatch UK

Dr Paul Rylott
Acting Chair of the Agricultural Biotechnology Council (ABC)

Ms Justine Thornton* (Convener of liability sub-group)
Barrister specialising in environmental law at Allen and Overy

Notes: Professor Keekok Lee, Visiting Chair in Philosophy at the Institute for Environment, Philosophy and Public Policy, University of Lancaster, was appointed to the Commission in October 2003, too late to be involved with this report. Dr Roger Turner, who convened the consumer choice and coexistence sub-group until mid-March 2003, left the Commission in July 2003.

A full list of members' declared interests can be found at http://www.aebc.gov.uk.

ANNEX G SELECT GLOSSARY

This glossary gives definitions applicable in the context of this report. Some terms may of course have different meanings in other contexts.

Items in italics are defined elsewhere in the glossary.

Abc	Agriculture Biotechnology Council: established to promote fair debate on behalf of the UK agriculture biotechnology industry regarding the potential production of GM crops in the UK. Companies involved include: Aventis; BASF; Dow Agrosciences; Dupont; Monsanto and Syngenta.
ACRE	Advisory Committee on Releases to the Environment: statutory body established under Part VI of the Environment Protection Act 1990, consisting of independent experts with a secretariat provided by *Defra*; advises the Government on the safety of proposed releases and marketing of *GMOs* and non-native species, and on related issues.
ACNFP	Advisory Committee on Novel Foods and Processes: a non-statutory, independent body of scientific experts that advise the *FSA* on any matters relating to novel foods (including genetically modified) and novel processes.
ACP	Advisory Committee on Pesticides: independent statutory body established to advise Ministers in the UK Government and devolved administrations on all issues relating to the regulation of pesticides.
Adventitious presence	Refers to the unintentional and incidental merging of small amounts of one type of seed, grain or food product with another.
AEBC	Agriculture and Environment Biotechnology Commission: established in June 2000 to give Ministers independent, strategic advice on developments in biotechnology and their implications for agriculture and the environment.
Agronomic	Refers to the application of the various soil and plant sciences to soil management and crop rotation
AP	*Adventitious presence*
BCH	Biosafety Clearing House
Biofuel	A gaseous, liquid or solid fuel derived from a biological source, e.g. ethanol, rapeseed oil or fish liver oil.
Bolter	Growth (on a beet) plant which leads to flowering if unchecked.
BRC	British Retail Consortium: trade association representing a whole range of retailers.
BSBPA	British Sugar Beet Producers Association
BSPB	British Society of Plant Breeders (a limited company)

Bt	*Bacillus thuringiensis*, a soil bacterium that produces toxins that control some insects.
CAP	*EU* Common Agricultural Policy
Cartagena Protocol	Protocol to the *CBD* on biosafety (signed in Montreal, January 2000), which regulates the trade and use of *GMOs* that could have an effect on the environment
CBD	Convention on Biological Diversity: signed by over 150 governments at the 1992 Earth Summit in Rio de Janeiro, its principal objectives are the conservation, sustainable use and equitable sharing of the benefits of the use of biological diversity
Commercialisation	Growing crops on a commercial scale, for the market, as opposed to on an experimental or demonstration basis.
Conventional agriculture	Used in this report to mean agriculture that, while not using *GM* crops, is not organic.
CPA	Crop Protection Association.
Cross-pollination	The transfer of viable pollen from an anther of one plant to a stigma of another plant.
CSL	Central Science Laboratory, an Executive Agency of *Defra*, which provides a range of scientific services, applied research and technical support to public and private sector customers, specialising in the sciences underpinning agriculture.
Defra	Department for Environment, Food and Rural Affairs.
Deliberate Release Directive	Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 designed to protect health and environment in the EU from any adverse effects that may be caused by the deliberate release into the environment of *genetically modified organisms* and repealing Council Directive 90/220/EC (OJ L106, 17 April 2001).
DNA	Deoxyribonucleic acid, a molecule which comprises the genetic material of most living organisms.
ELISA	Enzyme-Linked Immunosorbant Assay: a diagnostic test which uses the high specificity of enzymes and antibodies to detect the presence of specific substances in a sample, usually by the production of a distinctive colour change.
ENGL	European Network of *GM* Laboratories.
EPA	Environmental Protection Act 1990.
Erucic acid	A fatty acid, $C_{22}H_{42}O_2$, making up 40 to 50% of the total fatty acid in rapeseed, wallflower seed, and mustard seed.
EU	European Union.
EU Scientific Committee on Plants	An EU committee of experts which advises the European Commission on issues relating to the release of *GMOs*.

Feral	Existing in a wild state.
FSA	Food Standards Agency: established by Act of Parliament on 1 April 2000 with key functions including the provision of advice and information to the public and Government on food safety and protection of consumers through enforcement and monitoring.
FSEs	Farm Scale Evaluations, a 3-year programme allowing independent researchers to study the effect, if any, that the management practices associated with *GMHT* crops might have on farmland and wildlife, when compared with non-GM crops. Three crops were involved: oilseed rape (both spring and autumn sown); beet (fodder and sugar varieties); and maize. Results for the spring-sown varieties were published on 16 October 2003
Gene	A piece of DNA code, an instruction to build a protein which then forms part of, or does work in, a body. Sometimes a single gene determines an effect. But most processes that build and maintain bodies and plants involve many genes.
Gene flow	The movement of genes from one population to another.
Genetically modified	See *GMO*.
Gene stacking	Simultaneous presence of more than one *transgene* in an organism, usually a *GM* organism. Stacking may be induced deliberately or can also occur as a result of natural gene flow
Gene Use Restriction Technologies	Technology allowing plants to be engineered so as not to produce viable offspring or offspring which express a particular trait
Genotypic testing	Testing for the combination of alleles located on homologous chromosomes that determines a specific characteristic or trait
GM	Genetically modified: see *GMO*
GM construct	An artificially assembled DNA segment to be transferred into the target tissue. Typically, the construct will include the gene of a particular interest, a marker gene and appropriate control sequences
GMHT crop	*Genetically modified, herbicide-tolerant* crop.
GMO	Genetically modified organism: defined as an organism in which the genetic material has been altered by the direct introduction of DNA (specifically defined in EU legislation).
GURTS	*Gene Use Restriction Technologies.*
HEAR	High *erucic acid* oilseed rape.
Herbicide-tolerant (HT)	In the context of genetic modification, herbicide tolerance introduced by the insertion of a gene or genes capable of producing a gene product which inhibits or changes the effect of a herbicide on the plant (all crops are to some extent herbicide-tolerant).
Heterozygosity	Having different alleles (members of a pair or series of genes) of a particular gene.

Hybrid	A plant or animal that has been produced from two different types of plant or animal.
Hybridisation	The production of hybrids; *cross-pollination*.
IACS	Integrated Administration and Control Systems: determines the amount of money farmers receive from *CAP*.
Immunochromographic strip test	Testing of plant tissue for *GMO* protein. Qualitative test that shows whether or not the known construct being tested is present but does not reveal whether a given threshold has been breached.
Introgression	Infiltration of the genes of one species into the gene pool of another through repeated backcrossing of an interspecified *hybrid* with one of its parents.
IP	Identity preservation (also known as traceability): a system that tracks a product through all stages in a supply chain so that it can be traced back to its origins.
Liability	In law, the condition of being obliged by law or equity; answerable at law; obliged to pay or undertake some action.
LEAF	Linking Environment and Farming: a charity which aims to help farmers improve their environment and business performance, committed to a viable agriculture which is environmentally and socially acceptable.
LMC	Land Management Contract: a voluntary, legal contract between a Government department(s) and a farmer
LMO	Living Modified Organisms.
LMO-FPPs	Living Modified Organisms intended for direct use as Food or Feed, or for Processing.
Marker gene	A gene or short sequence of *DNA* that can be identified and tracked which acts as a tag for another, closely linked, gene on the same chromosome (the target gene). It is then used to check for the presence of the target gene.
Morphology	Scientific study of the structure and form of organisms without consideration of function.
Mutagens	Chemical agents that increase the rate of genetic mutation.
Negative testing	Testing for all known GM events.
NFU	National Farmers' Union
NIAB	National Institute for Agricultural Botany
Nucleotide	One of four chemical bases, namely Adenine, Cytosine, Guanine and Thymine that make up the molecule of DNA. (In RNA, Thymine is replaced by the base Uracil)

Nucleic acid sequence	A specific pattern of nucleotide subunits that make up the larger nucleic acid molecule i.e. DNA or RNA
Part C approval	Approval under Part C of the *Deliberate Release Directive* for *commercialisation* of a *GM* crop either for *commercialisation* or import or both.
Partially-restored hybrid	Containing a proportion (about 50%) of male sterile plants.
PCR	Polymerase Chain Reaction: technique used to replicate a fragment of *DNA* so as to produce many copies of a particular *DNA* sequence; commonly employed as an alternative to gene cloning as a means of amplifying genetic material for gene sequencing.
Phenotypic testing	Testing relying upon the visual inspection of plants and seeds for the expression of a specific trait based on genetic and environmental influences.
PMSU	Prime Minister's Strategy Unit.
Positive testing	Testing that a certain percentage of a crop is what it was meant to be, rather than seeking to determine the nature of any material other than the intended crop.
PSD	Pesticides Safety Directorate: an Executive Agency of *Defra*, which administers the regulation of agricultural, horticultural, forestry, food storage and home garden pesticides.
Environmental remediation	Putting right as far as possible environmental damage
RICS	Royal Institution of Chartered Surveyors.
RLR	Rural Land Register.
SCIMAC	Supply Chain Initiative on Modified Agricultural Crops, representing UK industry organisations throughout the primary supply chain (member organisations are *BSPB*, *CPA*, *NFU*, *UKASTA* and *BSBSPA*).
Separation distance	The distance between the boundary of a GM crop field and the boundaries of other crops which are sexually compatible with the GM crop.
Soil Association	An organic certifying body.
Threshold level	A quantity set by weight or number to define the maximum or minimum presence of one material in another (for example, the presence of *GM* grain in a batch of non-*GM* grain).
Tort	A civil wrong or injury arising out of an act of failure to act, independent of any contract, for which an action for damages may be brought.
Transgene/transgenic	Genes inserted by the direct incorporation of *DNA*, as opposed to endogenous genes.

UKAS	UK Accreditation Service, a non-profit-distributing company, limited by guarantee, which is the national accreditation body recognised by government to assess, against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services.
UKASTA	UK Agricultural Supply Trade Association
UKROFS	UK Register of Organic Food Standards
Varietal association	A crop variety containing more than one plant type (usually two, of which one acts as the pollinator, the other the pollinated).
Variety	A subdivision of a species: an agricultural variety is a group of similar plants that by structural features and performance can be identified from other varieties within the same species.
Volunteer	A crop plant growing in the wrong place, from self-sown or accidentally dropped seeds.
WTO	World Trade Organization.

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