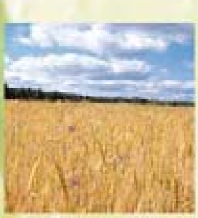

Utility, ethics and belief

in connection with the release of genetically modified plants

REPORT

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THE DANISH COUNCIL OF ETHICS
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Resumé
The report presents and discusses a number of the questions as regards values crucial to many people's approach to the release of genetically modified plants. A central issue is utility and utility assessments, but questions of sustainability and consideration for posterity, distribution of goods, agricultural developments, risk evaluation, natural philosophies and religion are also dealt with. Discussion is further given over to what should be the basis for legislating within the field, just as the relevant aspects of law and natural science are examined. In the final chapter the Council gives recommendations as to how utility should be included in the approval of genetically modified plants. The chapter also contains comments concerning developments in farming and sustainability.
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Preface

The debate on genetically modified plants is not just about scientific risk evaluations. It also has to do with more attitudinal questions of utility, ethics and belief. These are the issues most often vital to taking a personal stance, and they form the focus of this report. The report has been drawn up at the request of the Danish Minister for the Environment, Connie Hedegaard, who wished to have the particular issues mentioned taken on board in our deliberations.

The report has been considered at the Danish Council of Ethics' plenary sessions, based on a draft prepared by a working party on the Council. The working party consisted of Peder Agger (chairman), Klavs Birkholm, Ole J. Hartling, Thomas G. Jensen, Klemens Kappel, Niels Jørgen Langkilde, Anne Skare Nielsen, Anne-Marie Skov and Peter Øhrstrøm.

Some of the chapters in the report have been studied by experts with a view to ensuring that the factual information is correct. Rikke Bagger Jørgensen, PhD, biologist from the Risø National Laboratory, and Preben Bach Holm, DSc, of the Danish Institute of Agricultural Sciences, have read and commented on the chapter "Genetically modified plants – knowledge and perspectives". Jørn Borup, MA, PhD, Department of the Study of Religion at the University of Aarhus, and Mikael Rothstein, MPhil, PhD, Department of the Science of Religion at the University of Copenhagen, have read and commented on the chapter "Religious views" and parts of the chapter "Ecocentrism". Mercy Kamara, MSc (Sociology), PhD, of the Centre for Economic and Social Aspects of Genomics at Lancaster University, and Christian Coff, PhD, agronomist from the Danish Centre for Ethics and Law, have jointly drafted a memorandum on sustainability, which formed part of the background material to the Council's work. Thanks go to all those mentioned for their valuable input. For the sake of good order, it should be mentioned that the Council of Ethics is, of course, responsible for the final wording of the text. The report has been compiled by Henrik K. Jørgensen, MA, PhD, and Nanna Skriver, MSc, of the Council of Ethics' secretariat, on the basis of the working party's and the Council's discussions. The report was finally approved at the plenary meeting held on 17 August 2006.

September 2006

Ole J. Hartling
Chairman of the Danish Council of Ethics

Berit A. Faber
Head of Secretariat

Introduction

In the autumn of 2005 the Council of Ethics received an enquiry from the Danish Minister for the Environment, Connie Hedegaard, in which the Minister asked the Council to produce a statement on the concept of utility viewed in relation to the researching and application of genetic engineering. The enquiry revealed that the Minister was interested in identifying "the more intangible subjects that have so great a bearing on the public debate" and that do not concern risk evaluations, but rather involve utility, ethics and belief. The Minister made particular reference to the debate on the use of genetic engineering in the field of food.

The enquiry from the Minister for the Environment came after the Council of Ethics had its operational remit extended from 1 January 2005, inclusive, from having been just the field of health to also covering food as well as the field of nature and the environment. For the Council the enquiry was a welcome opportunity to crystallize the work already started on familiarizing itself with the new areas by addressing a specific issue. Since the Council had not previously taken up a position on problems in the field of nature and the environment, however, it considered it necessary to introduce its reply to the enquiry by identifying the fundamental ethical and legal problems that need to be related to in order to reach a qualified stance on the use of genetically modified organisms.[1]

The Council, however, chose to focus on the release and application of genetically modified plants. This was done in recognition of the fact that genetically modified organisms are widely used in other contexts,

1 Genetically modified organism is abbreviated to GMO, whereas the abbreviation GM stands for genetically modified.

without this apparently giving rise to any great controversies—amongst other things for producing enzymes, e.g. those used in washing powders or the manufacture of baking products. In the instances mentioned, however, the genetically modified organism is not present in the final product itself.

This report is characterized by the clarification process the Council itself has undergone. The Council has thus elected to publish a series of the texts formulated with a view to identifying the fundamental issues in the field in order to create a general overview. Chapters 1-9 are all of this nature, providing an overview, and with these chapters the Council hopes to have captured the topics central to the debate in a relatively easy-to-understand way. It should be noted that, in addition, the Council has had a separate memorandum formulated on sustainability, which can be read on the Council's homepage.[2]

From reading chapters 1-9 it will become clear that the issue of using genetically modified plants is a complex one: at one and the same time, the reader is forced to take a stance on a number of altogether diverse questions about, inter alia, risks (Chapter 2), international versus national regulations (Chapter 3), utility and social distribution of resources (Chapters 4 and 5), view of nature (Chapters 6 and 7), decision theory (Chapter 8) and political philosophy (Chapter 9). This can be difficult enough, but on top of that a number of the questions are highly indeterminate in nature, because it is not possible to completely map out the future consequences of using genetically modified plants. This, note, is due not merely to a lack of knowledge about risks, for example; it is also due to the fact that a number of the ethical key concepts are fairly vague or unclear. What, for instance, is the more precise meaning of a development being sustainable or a technology being useful?

The Council initially considered presenting its recommendations as scenarios, but the idea was rejected as the Council found that the complexity of the area makes it difficult to project meaningful visions of the future.

2 The memorandum can be downloaded at: www.etiskraad.dk. Kamara and Coff, 2006, GMOs and Sustainability: Contested Visions, Routes and Drivers.

Given the complexity of the field, therefore, the Council has chosen to focus its recommendations on the main issue in the enquiry from the Minister for the Environment, i.e. the role considerations of utility should play in approving the release of genetically modified plants. In the final chapter of the report the Council presents three main points of view relating to this question. The Council also presents some commentaries on the concept of sustainability and on whether genetically modified plants should be evaluated on the basis of an holistic assessment that includes ethical considerations.

The debate on genetically modified plants

The early eighties saw the demonstration of the first genetically modified plant. It was a tobacco plant that had been rendered resistant to antibiotics. But it would take a good ten years before a genetically modified plant came onto the market. In 1994, for the first time, consumers were able to buy tinned tomatoes made from the American-produced Savr Flavr tomatoes. They were genetically modified to enhance their taste and transport characteristics.

The news of the GM tomato received great public attention, but in Denmark the debate on GM plants and foods did not begin seriously until the freighter Hanjin Tampa arrived at the Port of Aarhus to great publicity in the press simultaneously accompanied by activist demonstrations in December 1996. The freighter was loaded primarily with ordinary soya beans, but mixed into the ordinary soya were a few percent of GM soya beans from Monsanto that had been made resistant to one of the company's greatest sales success stories, the broad-spectrum herbicide[3] Roundup.

Since 1991 the debate on genetic engineering had been relatively quiet in Denmark[4] otherwise, with a single news item featuring in the media every month at most.[5] But in the winter of 1996-97, when the Roundup soya reached the European market, the seed had been sown for debate and, more particularly, for the resistance that has followed GM plants and foods to this very day.

The great awareness and resurgence of resistance should probably be seen in the light of several factors. In spring 1996 the EU gave

3 Weed control agent.
4 Lassen et al., 2003, *Mere end risiko – om danskernes holdning til genteknologien.*
5 Bauer et al., 1998, Biology in the public sphere: a comparative review.

permission for products from Monsanto's genetically modified soya plant to be used in foodstuffs.[6] In prior years the EU had discussed different options for labelling GM products. Among other things, Denmark, Sweden and Austria had tried to implement a rule that GM raw products targeted at the food industry had to be labelled in order to give food producers and growers the advantage of being able to market products produced without the use of genetically modified organisms. But under pressure from the USA the EU finally had to accept GM products being imported unlabelled,[7] partly because the EU's then Directive on Deliberate Release 90/220/EEC made provision for demanding the labelling of genetically modified organisms only when safety considerations were at the basis.

By the end of 1996 there was agreement on the Council of Ministers that GM foodstuffs also had to be labelled if there were traceable chemical differences between the genetically modified and the corresponding conventional product, if there were possible ethical misgivings or if the product contained live genetically modified organisms.[8] But in cases where the authorities deemed the GM product to be substantively equivalent—that is to say, no different to the corresponding conventional product to any material degree—there was still no labelling requirement in the legislation.

When the first GM soya reached the European ports—and opinion polls showed that the European population in general was worried about biotechnological farming and food production[9]—politicians therefore had no way of accommodating the environmental and consumer organizations' requirements concerning labelling. At the same time, US soya producers dismissed the possibility of separating genetically modified and conventional soya beans. And since the USA is Europe's chief supplier of soya, and soya oil and soya lecithin are used in approx. 60% of all processed foods like margarine, pies and pâtés, ready-cooked meals, chocolate and biscuits, neither the food industry nor the consumers had any genuine scope for opting out of GM products.[10]

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6 European Commission, press release on 7.11.2003, State of play on GMO authorizations under EU law.

7 Ibid.

8 EBRA Bulletin, November 1997, Genetically-modified food – the debate continues.

9 Gaskell et al., 2000, Biotechnology and the European public.

10 EBRA Bulletin, June 1998, Genetically-modified food labelling scheme agreed.

The labelling conflict has probably been instrumental in providing grist for the mills of the campaigns conducted by Eurosceptics. When a Eurobarometer survey was again conducted in 1999, the proportion of sceptics had risen from 39% to 53%. Respondents were unable to see the advantages of using genetic engineering in food production and saw only few benefits to using GM crops.[11]

In June 1999 the popular resistance to GM crops and foods led to the Commission introducing a de facto moratorium—i.e. time for a pause to think—on the marketing of genetically modified organisms.[12] Five countries, including Denmark, spearheaded by its Social Democrats, demanded new, more stringent rules before they would once again issue marketing licences.[13] Amongst other things, they wanted changes to the tracing and labelling rules; and they wished to step up the requirements made of individual approvals, monitoring systems and environmental risk evaluations, which were criticized for only taking into account the direct effects of GMOs on human health and the environment without taking into consideration any cumulative long-term effects. And finally, it was highlighted that there was a need to investigate the value-based aspects of such risk evaluations and integrate ethical concerns in the approval procedure if the general acceptance of the public was to be achieved.[14]

In spring 2001 a new set of rules had been negotiated and finalized: European Parliament and Council Directive 2001/18/EC.[15] A large majority of the European Parliament and a large majority of the EU's member states agreed on the new directive, in which allowance was made for a number of the objections that had been put forward. Denmark was among the countries that voted in favour. But together with Austria, Luxembourg, France, Italy and Greece, Denmark maintained a blocking minority in terms of applying the directive until it was supplemented by a set of rules on tracing the mobility of GMOs through the production and distribution chain. Thus, it was not till the adoption of the EU's regulation on traceability and

11 Gaskell et al., 2000, Biotechnology and the European public.

12 Fisker, 2006, *Tænkepause til generne.*

13 Ibid.

14 Carr & Levidow, 2000, Exploring the links between science, risk, uncertainty and ethics in regulatory controversies about genetically modified crops.

15 For a more detailed description, see Chapter 3 'Legislation linked to the regulation of genetically modified plants'.

labelling,[16] which came into force in 2003, that the moratorium was formally lifted.

With the backing of Canada, Australia, Egypt and a number of Latin American countries, the USA had instituted an action with the WTO[17] beforehand to get the EU's block on the import of genetically modified goods lifted. According to the USA, the EU's moratorium constituted a trade barrier in violation of current WTO agreements, since GM crops did not differ in any relevant way, according to the USA, from conventional crops and could not therefore be made the subject of special requirements.[18] On 7 February 2006 the ruling was delivered. The World Trade Organization's three judges ruled that with their moratorium the Europeans had infringed international trading rules. The Americans called the ruling an important milestone for the USA's endeavours to get genetically modified crops accepted as part of international trade, whereas European officials claimed that the moratorium had already been lifted in 2004.

The fact is that there are still only very few GM products that have been approved since the moratorium was lifted,[19] and left to the discretion of the public at large, there is little prospect of many more 'genetically modified' foods making it into European supermarkets for the time being, either. The new, tighter requirements imposed on risk evaluations and the rules concerning traceability, labelling and coexistence[20] caused the Social Democrats to change course in the autumn of 2005 and pave the way for a genuine rescission of the moratorium.[21] But despite 10 years' debate and changes to rules, the population is still just as sceptical.[22]

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16 Regulation (EC) No. 1830/2003 of the European Parliament and of the Council concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC.

17 Abbreviation for the World Trade Organization.

18 Nordbo, 2003, *Ny miljøsag i WTO.*

19 European Commission's, Biotechnology, GMO products authorized under Directive 2001/18/EC.

20 Coexistence refers to the way GM crops can be grown without spreading to conventional and organic crops.

21 Friis, Danish Organic Farmers' Association's homepage, *Gensplejsede afgrøder skal bevise deres værd.*

22 In 2005 55% were sceptical, cf. Eurobarometer 64.3, May 2006, Europeans and Biotechnology in 2005: Patterns and Trends.

The debate on genetically modified plants still flares up at regular intervals. Do GM plants benefit the environment, or do they not? Will they contribute to remedying the hunger problems of the third world—or the opposite perhaps? Do they carry a particularly great risk potential? Is there any relevant difference at all between GM plants and conventional plants? Is the population's resistance due to ignorance? Is there any way of preventing GM crops from spreading to fields being cultivated with conventional or organic crops? Do they provide any benefits at all for the farmers or consumers? Should they be labelled and, if so, how? Are GM crops and foods compatible with sustainable development? And does nature have an integrity of its own that is violated when new species are created?

There are still a great many questions, and despite 10 years of debate the wings are far from having reached a consensus. With this statement the Danish Council of Ethics has no intention of definitively identifying or, for that matter, clarifying the many dilemmas and questions that have been thrown up. But it is our desire to generate renewed debate on the use of genetically modified plants with the focus on the attitudinal issues surrounding utility, ethics and belief. These questions take up a large part of the personal decision on GM plants but have been less prominent in the public debate.

[potato]

Genetically modified plants – knowledge and perspectives

Man has been breeding plants for as long as he has been tilling the soil. Initially, it was merely by collecting seeds and selecting the best plants every year—plants that produced a bigger yield, plants with greater resistance to pests or plants better able to tolerate periods of drought, cold or intense precipitation. Later on, systematic efforts were begun to impart new properties to plants, amongst other things by crossing or hybridizing different species in order to thereby combine their useful characteristics; and by irradiating or in some other way provoking mutations in the plants that might or might not impart desirable new qualities to the plants.

Yet traditional methods of breeding are restricted by the fact that breeding processes are slow and by the general inability to cross plants belonging to different species. Genetic engineering opens up new vistas, however, because in principle this technology enables a piece of genetic material to be removed from any organism whatsoever and inserted into another. As a result, plant breeding with the aid of genetic engineering has two advantages over traditional plant breeding techniques. The technique is more efficient and enables species barriers to be crossed, thus opening the way to endow plants with altogether new types of characteristics. Plant researchers have therefore seen great potential in the new technology, which many feel will be able to be put to positive use in further developing agriculture.

The spread of genetically modified plants

A GM plant is one that has had one or more chunks of new DNA inserted into its genetic material with the aid of genetic engineering. The DNA can originate from other plants, from bacteria, from animals or from people.

The first GM plant approved for marketing was the American tomato Flavr Savr (flavour savour). The tomato was developed by a company called Calgene Inc. in 1994 and first sold in the USA in 1996. The objective of Flavr Savr tomatoes was to make tomatoes with a longer shelf-life and improved transport characteristics so that unlike traditional tomatoes the Flavr Savr ones had chance to ripen on the vine and thus accumulate and retain a better taste. In England tomato purée was made from Flavr Savr tomatoes. It was a commercial success initially—people thought it tasted better, the tins were 25% larger than conventional ones and featured a big yellow label stating that the article was genetically modified. The GM tomato purée was only taken off the shelves when criticism of GM plants and foods began. The tomatoes also turned out to be less transportable than originally assumed. And since they were also more expensive than traditional tomatoes, they never really became a commercial success; today they have been taken off the market.

Since the Flavr Savr tomato, global production of GM plants has increased steadily, so that in 2005 GM crops were being grown commercially on a total of 90 million hectares of land spread over 21 countries. By way of comparison the total area of cultivated farming land in Denmark is just under 2.7 million hectares. The USA accounts for more than half of total production, thus making it the country that grows most GM crops, followed by Argentina, Brazil, Canada and China. The list of countries producing GM crops also includes five EU countries: Spain, Germany, Portugal, France and the Czech Republic, although their spread is still very limited here.[23]

Although the spread of GM plants has also risen steadily since the Flavr Savr tomato reached the shops, the variation in GM plants being marketed is still limited, as regards both the varieties of plant and the genetic modifications that have been undertaken. Primarily, then, four GM plant species are currently being cultivated on a commercial basis: soya beans make up 60% of the global area cultivated with GM crops, while maize makes up 24%, cotton 9.8% and rape 5% of the global area. And unlike the Flavr Savr tomato, which had had its

23 James, 2005, Executive Summary of Global Status of Commercialized Biotech/GM Crops: 2005, ISAAA *Briefs* No. 34. ISAAA: Ithaca, NY. http://www.isaaa.org/.

Table 1: Global spread of genetically modified plants in 2005[24]

Country	Area (millions of hectares)	Genetically modified crops
USA	49,8	Soya beans, maize, cotton, rape, squash, papaya
Argentina	17,1	Soya beans, maize, cotton
Brazil	9,4	Soya beans
Canada	5,8	Rape, maize, soya beans
China	3,3	Cotton
Paraguay	1,8	Soya beans
India	1,3	Cotton
South Afrika	0,5	Maize, soya beans, cotton
Uruguay	0,3	Soya beans, maize
Australia	0,3	Cotton
Mexico	0,1	Cotton, soya beans
Romania	0,1	Soya beans
Filippines	0,1	Maize
Spain	0,1	Maize
Colombia	<0,1	Cotton
Iran	<0,1	Rice
Honduras	<0,1	Maize
Portugal	<0,1	Maize
Germany	<0,1	Maize
France	<0,1	Maize
Czech Republic	<0,1	Maize

quality characteristics altered, nearly all the GM plants currently on the market have only had their growing properties modified. Thus 71% of the total area cultivated with crops has been rendered tolerant to herbicides, i.e. resistant to particular weedkillers. 18% of the area has been cultivated with crops that have been rendered resistant to insects, the so-called Bt crops. And the remaining 11% of the area is

24 Ibid.

cultivated with crops that have been endowed with both herbicide tolerance and insect resistance.[25]

Examples of a plant that has been genetically modified with a view to altering its growing characteristics include maize line 1507 – CRY1F, which on 3 November 2005 was approved by the European Commission for import and processing in the EU. 1507 maize has had two traits added. Firstly, it has had the *Cry1F* gene inserted from the bacterium *Bacillus thuringiensis*, meaning that it produces Bt toxin. Bt toxin is used in both conventional and organic farming to control attacks from certain caterpillars, attaching itself to specific receptors in the alimentary canals of insects, where it perforates the cell membrane. By transferring the *Cry1F* gene to the maize, however, the maize itself has been made capable of resisting attacks from the caterpillars, thereby eliminating the need to spray the crops. Secondly, the maize line has had the pat gene inserted from the bacterium *Streptomyces viridochromogenes Tü 494*, rendering it tolerant to herbicides containing the active ingredient glufosinate ammonium (for example, Basta). Since herbicides with the active ingredient glufosinate ammonium are broad-spectrum, cultivating these GM crops is supposed to be less labour-intensive than traditional varieties because they need only be sprayed with one herbicide. At the same time, herbicide-tolerant crops are supposed to give farmers the opportunity to introduce "no-tillage", which is to say that they no longer plough and harrow, but sow herbicide-tolerant crops between the stubble of the old crops instead and keep the weeds in check with broad-spectrum herbicides. On the one hand it saves time and fuel, results in better humus formation, retains moisture and reduces earth drift, which is a problem in dry climates. On the other hand no-till can also lead to greater problems with weeds, insects and attacks of disease, smaller yields, problems with incorporating sparingly soluble nutrients in the lower strata of earth and a later sowing time.

Genetically modified plants in the future

The vast majority of GM crops being marketed have been made

25 James, 2005, Executive Summary of Global Status of Commercialized Biotech/-GM Crops: 2005, ISAAA Briefs No. 34. ISAAA: Ithaca, NY. http://www.isaaa.org/.

herbicide-tolerant and/or insect-resistant, therefore. But many new plants are being developed and plant researchers all over the world cherish a vision and conduct experiments to develop plants with desirable new qualities. Thus, China alone developed 47 new GM plants in 2005.[26] Plant researchers are hoping, amongst other things, to develop plants that are tolerant to environmental stressors such as drought, cold and high salt concentrations; plants resistant to viral, fungal or bacterial attack; plants with altered qualitative characteristics, such as rice with a higher vitamin-A content and potatoes with an altered starch content which, in different variations, will be better suited to the paper industry, for instance, and able to be used to produce low-fat crisps and chips because they absorb less fat when deep-fried; plants better able to exploit soil- and airborne nutrients; plants with a better flavour; and plants which, like the Flavr Savr tomato, have a longer shelf-life once harvested.[27]

Many of these plant types are still only at very preliminary stages of development; others are being tested in the laboratories, whereas still others are being trialled "in the field". In Europe, for example, a number of different maize plants currently being tested have had genetic material added with a view to improving grain quality, making the plants better at utilizing nitrogen, improving their ability to perform photosynthesis in times of drought and reducing the plants' lignin content to make them better suited for forage. There are also field trials in progress on grapes, sugar beet and tobacco which scientists have attempted to make virus-resistant, with poplars that have had their lignin content reduced in order to make them better suited for paper production, with rape that has been genetically modified with a view to altering the oil composition,[28] and in the EU a Swedish application is currently being considered to market a potato that has had its starch composition altered so that the potato starch is better suited to coating paper.[29]

26 China education and research network: http://www.edu.cn/20051206/3164500.shtml.

27 Pew Initiative on Food and Biotechnology, 2001, Harvest on the Horizon: Future uses of Agricultural Biotechnology.

28 European Commission Joint Research Centre. Biotechnology & GMOs Information Website.

29 EU database containing information about all GM plants that have been approved or are pending processing: http://www.GMO compass.org/eng/gmo/db/17.docu.html.

The genetically modified cassava plant may illustrate the possibilities and difficulties associated with the GM plants of the future.

The cassava plant is drought-tolerant and does not necessarily have to be harvested at a particular time, enabling it to serve as a standby for leaner periods. Cassava is the third most important crop in tropical countries, where approx. 500 million people, particularly in Africa, are dependent on the plant's starchy roots as their staple foodstuff. Depending on variety, however, cassava roots contain between 50 milligrammes and 1 gramme of toxic hydrogen cyanide per kilogramme of dry weight, which means that it needs to be processed before being ingested—a process that unfortunately results in most of the proteins, vitamins and minerals being lost as well. Since this processing is a long, drawn-out affair, processing of the cassava is sometimes not completed, resulting in several cases of death and chronic suffering every year. Leaching out cyanogenic glucosides puts a further strain on the environment, as cyanide is released into the atmosphere and watercourses.

With the aid of genetic engineering it is now possible to inhibit the formation of two enzymes crucial to the synthesization of cyanogenic glucosides and in this way reduce the amount contained in the roots by 92%. The genetically modified cassava does not need to be processed before being ingested, therefore, and so should be able to contribute to improving the state of nutrition in third-world countries, reducing the impact on the environment and so on.

Conversely, there is a risk of GM cassava plants being more vulnerable because the cyanogenic glucosides apparently make up part of the plant's natural defences against attacks from pests.[30]

Useful, harmful or risky?

At first sight it may seem perfectly sensible to develop and possibly even use many of the plants described above, but this is not a subject of broad-based consensus. Since the first GM plants were cultivated, there has been discussion as to whether they will actually contribute

30 Riis et al., 2003, Cyanogenic Potential in Cassava and its Influence on a Generalist Insect Herbivore *Cyrtomenus bergi* (Hemiptera: Cynidae).

to any real-term public utility or whether, on the contrary, they pose a threat to our ecosystems and our health.

One of the causes of the major disagreement is the difficulty of evaluating the consequences of taking GM plants into service, even where an altogether specific GM species is involved. This is due not only to the actual consequences depending on a number of very disparate considerations but also to each of those considerations involving some uncertainty, due partly to lack of knowledge and experience.

The direct impact of the genetically modified plant

First and foremost, the GM plant per se can have a direct impact on the environment, on animals or on human health. This impact can either be intentional, and hence desired, as is the case for example with the so-called bt-plants, which produce a toxin that kills caterpillars if they attempt to attack the plant, or they can be unintentional, as has been observed inter alia in a genetically modified potato plant, which compared with the control plants turned out to produce lower concentrations of glycoalkaloids, which normally protect the plants against attacks from pests[31] and in a bt-maize that turned out to produce 33–97% more lignin than the control plants, which can have both positive and negative effects on the environment.[32]

Such unintentional effects can occur for a number of reasons. For instance, the inserted gene can have effects other than those predicted, because it intervenes with the regulation of other genes in some way. It transpires that genes and their regulation are considerably more complex than originally assumed. The supposition that there is a simple correlation between gene and function—and that there is a one-way flow of information from DNA to RNA and on to protein—has been radically rethought. Amongst other things, it turns out that proteins can be formed on the basis of several DNA sequences, and that some DNA sequences can translate into several

31 Birch et al., 2002, The effect of genetic transformations for pest resistance on foliar solanidine-based glycoalkaloids of potato *(Solatium tuberosuni).*

32 Saxena & Stotzky, 2001, Bt corn has a higher lignin content than non-Bt corn.

different proteins. Moreover, it has been realized that not all RNA sequences translate into protein. Some RNA sequences have independent functions in the cell, like influencing which genes are expressed. If a DNA sequence is inserted into an organism, therefore, there may be a risk of that gene, the derived RNA sequence or the gene product influencing the regulation of other genes.

Unintentional effects can also arise because the genetic engineering methods in use today take away full control of the process. That means that during the actual transfer of DNA, for example, there may be a risk of interrupting other genes, creating so-called open reading frames[33], which can inadvertently code for a protein or a peptide[34], or intervene in the production of RNA and in that way bring about undesirable characteristics.

These days it is attempted to avoid such inadvertent effects by performing risk evaluations. First it is investigated whether the products from the DNA sequence(s) transferred have characteristics that can cause undesired effects. This is done in part by conducting dose response studies, in which experimental animals are given different doses of the GM plant and the animals' response recorded. The possible consequences of each adverse effect are then evaluated, if they occur, and the probability of their occurring evaluated; and finally, an overall evaluation is made of the risk entailed by each characteristic demonstrated.[35]

Although risk evaluations are performed, however, it is obvious that all risks can never be pinpointed; this is partly to do with the complex regulation and technical uncertainties making it difficult to foresee what effects can occur, and hence also difficult to assess what to check for. This problem is also known within other domains, including the chemical industry, where there are numerous examples of substances subjected to thorough risk evaluations still turning out to have detrimental effects. For instance, it is only within recent years that

33 An open reading frame is a piece of the DNA string that has the potential to translate into a protein.

34 Peptides are short chains of amino acids.

35 EU's Deliberate Release Directive: Directive 2001/18/EC of the European Parliament and of the Council, Appendix II, p. 5 ff.

there has been an awareness that phthalates can be disruptive to hormones, that contraceptive pills can cause blood clots, and that straw shorteners can impair sperm quality and thus reproductive capacity in animals and maybe even in humans.

Indirect impact

Releasing genetically modified plants also has a number of indirect effects. When a farmer switches to growing herbicide-tolerant crops, for example, he alters farming practice by changing from using several different herbicides to using one broad-spectrum one—just as a farmer will change farming practice if he switches from growing conventional crops to growing insect-resistant crops, since he will not need to spray his fields as often. Such modified farming practice could make it more profitable to run the farm and reduce its environmental footprint. But perhaps that will not be the case. The inhabitants of African countries may also enjoy better health if they start growing GM cassava, because it requires less processing and therefore retains its vitamin content to a greater degree. Just as inhabitants of the West may also become less overweight if the fast-food chains and crisp manufacturers switch to using GM potatoes with increased starch content. And maybe the environment will improve if the paper industry switches to using GM potatoes with a modified starch composition, because it takes fewer chemicals to process the potato starch from GM potatoes than from conventional potatoes.

However, it is difficult to gauge exactly what indirect effects the release of a particular GM plant will have, as such indirect effects are characterized by their dependence on factors other than the GM plant itself.

The environmental impact of growing herbicide-tolerant crops depends, for example, on how they are cultivated, i.e. on how much of the broad-spectrum herbicide the individual farmer chooses to spray on his fields, on when he sprays them and on whether he switches to no-till[36], which in turn depends on different cultural and social circumstances. The environmental impact also depends on whether the weeds develop a resistance to the broad-spectrum herbicide, so

36 Hails, 2002, Assessing the risks associated with new agricultural practices.

that the farmer has to spray with several different herbicides after all; on the surrounding environment and the natural vegetation, which may have a bearing on whether, say, the gene spreads to cognate wild species, which subsequently run the risk of growing as weeds on cultivated fields;[37] and on how many other farms grow plants with the same herbicidal tolerance, as widespread use of a single herbicide can increase selection pressure on the weeds and thus end up undermining the effect of the herbicide.[38]

In the same way, the success of the cassava in third-world countries depends partly on whether removing the cassava's natural protection—the cyanogenic glucosides—will leave it increasingly open to attacks from rodents, insects and suchlike, and whether social circumstances allow the GM cassavas to be segregated from the conventional ones. And the possibility of the GM potato, which can be used to make low-fat crisps and chips, having a positive effect on reducing obesity in the West depends on how consumers react to the products—will they carry on eating as before, only low-fat? Or will they use the low-fat crisps as an excuse to eat more crisps or top up on other foods?

The many different factors that play an instrumental part in the actual consequences of marketing a particular GM plant make the job of evaluating both useful and harmful effects complex. As a result, it may turn into a question of attitudes or interests, whether people feel that GM plants will actually have a useful effect, and whether the risk evaluations adequately identify the risk potential of the GM plants.

The debate

In slightly crude terms, the public debaters and their arguments can be set out in two groups, representing a sceptical and a more positive wing, respectively.

Among the sceptics, arguments including the following are emphasized:

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37 Senior & Dale, 2001, Review – Herbicide-tolerant crops in agriculture: oilseed rape as a case study.

38 Benbrook, 2003, GMOs, Pesticide Use, and Alternatives – Lessons from the U.S. Experience.

That genetically modified plants—despite risk evaluations—may prove to have harmful effects. The point is put forward by Carr and Levidow, among others, who insist that in regulatory contexts it is exclusively a matter of risks—that is to say, a known probability that a specific harmful effect will occur, even though part of the uncertainty associated with the release and application of GM plants is linked to wide-scale ignorance, given that there is no overview of the possible consequences that can actually arise.[39] There is therefore a risk that some of the unintentional effects that have been documented as occasionally occurring will not be discovered during risk evaluations. Since genetic engineering has further enabled species barriers to be crossed, and the development of new plant species takes place far more quickly, that means that any adverse consequences may have reached an unacceptable level before action is taken. Weaver & Morrice and Ellestrand et al. mention, inter alia, that in connection with the release and application of GM plants there is a risk that: crossbreeding will occur between the GM crops and their wild relatives, which can subsequently occur as weeds in fields, with increased pesticide consumption as a result; biodiversity in natural plant communities will be impacted if the inserted genes spread to wild species and endow them with better adaptability, allowing them to spread at the cost of other species;[40] cultivating bt-plants, say, will impact negatively on non-target organisms, with a resultant loss of biodiversity; and the risk of long-term resistance developing in insects and weeds will lead to increased use of pesticides.[41] Recent studies of Chinese cotton growers' insecticide usage indicate here that although the 'bt'-farmers sprayed their fields 70% less than conventional farmers during the early years, the problem with secondary pests had become so great in 2004 that the 'bt'-farmers used just as much spray pesticide as other farmers.[42] Of the other risks mentioned in the

39 Carr & Levidow, 2000, Exploring the links between science, risk, uncertainty, and ethics in regulatory controversies about genetically modified crops.

40 Ellestrand et al., 1999, Gene flow and introgression from domesticated plants into their wild relatives.

41 Weaver & Morris, 2005, Risks associated with genetic modification: an annotated bibliography of peer reviewed natural science publications. See also: Stewart et al., 2003, Transgenic introgression from genetically modified crops to their wild relatives.

42 Lang, 2006, Seven-year glitch: Cornell warns that Chinese GM cotton farmers are losing money due to 'secondary' pests.

debate Marmiroli points to the fact that there is also a risk of: antibiotic resistance marker genes being transferred to bacteria; organically cultivated fields being contaminated with GM plants, with ensuing financial losses for the farmer; the spread of GM plants leading to a higher degree of monoculture; allergens or nutritionally harmful components being able to develop in plants as a result of the genetic material added, either because the product of the transferred gene is allergenic in its own right or because the introduction of the gene sequence affects gene regulation in the plant so that it produces proteins it would otherwise not have produced;[43] and finally, Hamann expresses concern that invasive spread will occur—particularly at the genetic level, with adverse consequences for biodiversity as a result.[44]

That the development will be irreversible. The risk of a cross between GM cultivars, conventional related species and their wild relatives is unavoidable.[45] If a GM plant turns out to have serious inadvertent effects, it can also have extensive irreparable harmful consequences, since stopping cultivation of the GM crops will be of no use once the genes have spread. Whereas most chemical substances have a half-life, after all, genes are part of a living organism and can thus be propagated independently of man, once released.

That, ultimately, the release of genetically modified plants will not benefit society. Friends of the Earth point out here that virtually exclusively herbicide-tolerant and insect-resistant crops have been marketed, and that these have supposedly benefited neither the environment, farmers or third-world countries.[46] Thus reference is made to studies indicating that the consumption of herbicides in the USA is higher in fields cultivated with herbicide-tolerant crops than fields cultivated with conventional crops,[47] and that the consumption

43 Marmiroli, 2005, Transgenic Organisms: Enthusiasm and Expectations as Compared with the Reality of Scientific Research.

44 Hamann, 2001, *Bioinvasioner – et globalt problem.*

45 Eastham & Sweet, 2002, Genetically modified organisms (GMOs): The significance of gene flow through pollen transfer.

46 Friends of the Earth, 2006, Who benefits from GM crops? Monsanto and the corporate-driven genetically modified crop revolution.

47 Benbrook, 2004, Genetically Engineered Crops and Pesticide Use in the United States: The First Nine Years.

of herbicides per hectare of land cultivated with herbicide-tolerant soya is twice as high in Argentina as in the USA.[48] Among the more sceptical, emphasis is also given to the most comprehensive field trials to date, which present an ambivalent picture, since cultivating herbicide-tolerant beets, spring rape and winter rape turned out to have an adverse effect on wildlife as compared with cultivating corresponding conventional species.[49] And studies are emphasized that show that it has had no substantively positive effect on farmers' finances in the USA,[50] which is the leading grower of GM crops. The production of GM crops in Argentina, the world's second-largest producer of GM crops, has led amongst other things to loss of food sovereignty, landscape degradation, soil depletion, species loss and concentration of the agroindustry.[51] Furthermore, there is some distrust among sceptics as to whether GM crops with any usefulness for third-world countries will even be developed. It is a widespread view that nutritional problems like obesity in the West and vitamin deficiencies in third-world countries can be better addressed in other ways.

That genetically modified plants will result in inappropriate structural change to global farming. Since the invention and spread of farming in the Neolithic Stone Age it has been customary for farmsteads—collectively or individually—to control their own crops and themselves determine the quantities they would use as sowing seed for the next crop. GM crops are patented, however. That means that the right to grow them still has to be acquired from the patentholder.

That heralds a structural change in global farming that sceptics find alarming. Farmers will be deprived of their hold over farming—over the rhythms of the year and the day, soil improvement, fertilization, development of cultivation methods, breeding of plants etc.—and instead it will pass to transnational knowledge-based enterprises whose forte is winning patents.

48 Benbrook, 2003, GMOs, Pesticide Use, and Alternatives – Lessons from the U.S. Experience.
49 Burke, 2003, Managing GM crops with herbicides – Effects on farmland wildlife.
50 Benbrook, 2003, GMOs, Pesticide Use, and Alternatives – Lessons from the U.S. Experience.
51 Pengue, 2005, Transgenic Crops in Argentina: The Ecological and Social Debt.

Nonetheless, that is the actual driving force behind market growth when it comes to GM organisms. Among other things, a number of the world's largest chemical companies have acquired patents on plant cells and plant components over the past twenty years. Where the ability to develop and market new chemicals was once crucial as one of the 20th century's key industries, patents on genes and genetically modified organisms now seem to be the focus of commercial commitment. The provisional result is that ten multinational seed companies control more than half the world's total trade in sowing seed:

Table 2: The world's 10 largest seed companies[52]:

1.	Monsanto (+Seminis pro forma)	USA	DKK 16.4 billion
2.	Dupont/Pioneer	USA	DKK 15.2 billion
3.	Syngenta (Switzerland)	Switzerland	DKK 7.2 billion
4.	Groupe Limagrain	France	DKK 5.1 billion
5	KWS AG	Germany	DKK 3.6 billion
6.	Land O' Lakes	USA	DKK 3.1 billion
7.	Sakata (Japan)	Japan	DKK 2.4 billion
8.	Bayerische CropScience	Germany	DKK 2.3 billion
9.	Taikii	Japan	DKK 2.1 billion
10.	DLF-Trifolium	Denmark	DKK 1.9 billion

As yet the market for commercial sowing seed is only about DKK 125 billion a year (by way of comparison, the global market for spray pesticide and weed control is DKK 206 billion and the pharmaceutical market DKK 2.7 trillion). But despite the transition to the industrial and information society, agriculture still makes up the basic global livelihood that forms the first link in the human food chain. The transformation of ownership in progress thus has potentially wide-ranging consequences for food security.

A company like Monsanto currently controls 41% of the entire world's trade in maize seed and 25% of the world market for soya beans. In 2004 Monsanto's patented products are available in 88% of the entire

52 The figures cover the sale of seed in 2004 etc., 2005, Global Seed Industry Concentration – 2005.

global area cultivated with GM crops. Monsanto buys up competitors, and this monopolistic concentration on the seed and sowing seed market can give rise to concern.

These new economic conditions in agriculture may mean that the world's food supply will become dependent on the market—including, for instance, dependence on fluctuations in share prices. Decisions once made on each individual farm will now be made in the board rooms of the conglomerates—and an overriding consideration here will be the return for shareholders. In addition, a study from the US Department of Agriculture[53] suggests that research and development in farming is determined by the biotech industries' growing control of the business.

Among players who take a more positive approach, arguments including the following are highlighted:

That risks associated with the release of GM plants bear no appreciable difference from those associated with traditionally improved crops. In this context Harlander points out that GM crops do not differ substantially from traditionally bred crops grown, for example, with the help of mutation breeding, as these have had their genetic material modified too, only without resort to genetic engineering.[54] Since altogether random mutations are induced by breeding methods like mutation breeding, the breeding method also involves risks, as is the case with 'traditionally' genetically modified plants. Thus conventionally bred plants can also turn out to have maverick effects; and just as with GM species, there is also the potential risk of these crops spreading and thus triggering an irreversible development. Carrying on from this, it is often stressed that plants manufactured with the aid of genetic engineering are in many ways actually safer than plants manufactured with the aid of mutation breeding, because there is more control over the genetic changes undergone by the plant. Conner et al. further point out that the attributes imparted to the transgenic plants by means of genetic

53 US Department of Agriculture (USDA), 2004, Have Seed Industry Changes Affected Research Effort?

54 Harlander, 2002, The Evolution of Modern Agriculture and its Future with Biotechnology.

engineering largely resemble those that for many years have been induced with the aid of traditional breeding methods, so that the impact on, say, the environment can only be coterminous.[55] However, the risks can largely be reduced through in-depth risk evaluations, though it is essential to be aware that any development will involve some risk. In this connection Harlander, and others, emphasizes that traditionally bred crops, unlike genetically modified ones, are not subject to any evaluation requirements at all, so that in this respect GM crops can be considered safer.[56]

That the release of GM plants has already benefited society and will be able to contribute even more useful effects in future. Phipps & Park thus point out that the marketing of GM plants has already had a number of socially beneficial effects. For example, studies indicate that the introduction of herbicide-tolerant and insect-resistant soya, rape, cotton and maize cut global pesticide consumption by 22.3 million kg in 2000[57], while Brookes & Barfoot's studies indicate that the introduction of GM crops has had a particularly positive effect on agricultural income, equivalent to those farms growing GM crops having had extra earnings of between 19 and 27 billion dollars from 1996 to 2004.[58] Inter alia, reference is made to studies showing that cultivating Bt cotton (cotton resistant to caterpillar attacks) has resulted in improved finances and health for poor small-scale farmers in China, as the plants require no pesticides.[59] The pesticides/-insecticides used on caterpillars are highly toxic, and cotton requires the use of more pesticides than other crops. Trials in the USA also show that using Bt cotton cuts down on insecticide use. A positive spin-off of Bt cotton is that the reduced spraying results in greater biodiversity.[60] In addition, those who take a more positive view of the

55 Conner et al., 2003, The release of genetically modified crops into the environment.

56 Harlander, 2002, The Evolution of Modern Agriculture and its Future with Biotechnology.

57 Phipps & Park, 2002, Environmental Benefits of Genetically Modified Crops: Global and European Perspectives on their Ability to Reduce Pesticide Use.

58 Brookes & Barfoot, 2005, GM crops: the global socioeconomic and environmental impact – the first nine years, 1996 – 2004.

59 Pray et al., Five years of Bt cotton in China – the benefits continue.

60 Cattaneo et al., 2006, Farm-scale evaluation of the impacts of transgenic cotton on biodiversity, pesticide use, and yield, PNAS.

technology stress that developing GM crops has the potential to redress the food shortage in the third world, create healthier foods and so on.

That monopolization within agriculture is not associated with the development of genetically modified plants.
Two factors in particular are highlighted in this connection. Firstly, patents can also be taken out on plants developed with the aid of conventional breeding methods; and secondly, those patents have no bearing on the formation of monopolies. Consolidation/monopolization is taking place throughout the western world, and Eastern Europe and Asia are rapidly following suit—including in the rest of the agricultural sector, IT and the retail trade, where hundreds of small grocers are closing because consumers are shopping at the Walmarts, Lidls and Carrefours of this world. It is pointless, therefore, to try to fight monopolization by slowing down the development and use of GM plants.

A difficult call
As has been shown, it can be difficult to assess and agree whether GM plants are useful or harmful and whether the risks are higher or lower than with traditional breeding. One of the problems, of course, is that there are many different types of GM plants. They can be potatoes, maize, soya beans, rice etc. that have been rendered e.g. herbicide-tolerant, insect-resistant, have had their starch content changed or have been made more oily. And such plants can be cultivated in many different countries subject to different cultural conditions and agricultural traditions. For the same reason, GM plants today are evaluated on a case-by-case basis, as will also become clear from the following chapter. But even when plants are considered individually, it is difficult to reach a consensus, partly owing to the lack of agreement about the premisses governing the evaluation. If, for instance, the plant is not harmful per se, but the modified agricultural practice that follows in the wake of cultivating it can have adverse consequences for biodiversity, should that then have any influence on whether the plant is approved for marketing, or should the use of pesticide consumption be regulated instead? Should regulation in any way be influenced by the fact that developing them has resulted in plants being made sterile, eliminating the formation of sowing seed,

and increasingly being patented by multinational companies? Should the possible usefulness of a GM plant influence the approval procedure, and what does being useful even mean? Or should marketing authorization be based purely on whether or not the plant is detrimental to the environment and human health?

The discussion has many layers, therefore. For example, it is relevant to discuss what should be regarded as harmful and useful consequences, respectively, before being able to evaluate whether a particular plant is actually useful or harmful.

Below, we shall describe current legislation in the field first before passing on to a discussion of the concept of utility.

Legislation linked to the regulation of genetically modified plants

The release and marketing of GM plants has been regulated by the EU. Below we shall examine the EU directives that regulate the release and marketing of GM plants and subsequently describe the openings and constraints that exist in the international agreements if it is wished to include parameters in the regulation other than those that already exist. The "Norwegian model" will then be described as an alternative regulatory form, and the Danish Medicinal Products Act and the new chemicals agreement REACH will be briefly examined in order to compare core parts of the legislation concerning the release of GM plants with relevant items of related legislation.

Regulation in the EU

A GM plant can only be used when permission has been issued by the relevant authority. In the legislation a general-level distinction is made between three applications of GM plants:

- Use of GM plants under contained conditions.
- Use of GM plants for trial release.
- Use of GM plants for release and marketing.

The use of GM plants under contained, enclosed conditions and the use of GM plants for trial release are national matters, whereas approval of GM plants for release and marketing is a collective EU decision, which has been regulated by European Parliament and Council Directive 2001/18/EC *on the release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC*, implemented in Denmark by the Act on the Environment and Genetic Engineering (Consolidation Act No. 981 of 3 December 2002).[61] Once a GM plant has been approved for marketing in an EU

61 The more detailed rules of the Release Directive are contained in the Danish Ministerial Order on the Approval of Release into the Environment of Genetically Modified Organisms (BEK No. 831 of 03/10/2002).

country, it can also be marketed in any of the other EU countries without any further licences or permits.

If the member country that has received the application for marketing authorization deems that the GM plant in question can be approved for marketing, the evaluation report is sent to the European Commission. From here it is sent on to the competent authorities in the other member states, each of which makes its own evaluation and recommendation. In Denmark the National Forest and Nature Agency is the authority in charge. The National Forest and Nature Agency consults other authorities and organizations affected[62] and must inform the public in order to give it the opportunity to comment.[63]

If there are no objections to the evaluation report from the Commission or the other member states, the first applicant country can issue permission to market the GM plant. If there are objections, the Commission consults its scientific committees before making a decision. If the official committee in the field rejects the application, it is sent for the vote of the Council of Ministers, which can reject or accept the application by qualified majority voting.

Environmental risk evaluation

The primary purpose of the EU's release directive is to ensure that, in accordance with the precautionary approach[64], no undesirable effects are caused to human health and the environment as a result of releasing or marketing genetically modified organisms.[65] It is therefore stipulated that any GMO must be environmentally risk-evaluated before it can be marketed.[66] The competent authority in the first applicant country is responsible for the evaluation. The authorities themselves, however, do not conduct the scientific trials, taking the studies and information provided by the producer/grower as their basis instead.

62 Danish Act on Environment and Genetic Engineering, Section 9a, subs. 1.

63 Danish Act on Environment and Genetic Engineering, Section 9a, subs. 2, and Directive 2001/18/EC of the European Parliament and of the Council, Article 24.

64 For a more detailed description see Chapter 10.

65 Directive 2001/18/EC of the European Parliament and of the Council, Article 1.

66 Directive 2001/18/EC of the European Parliament and of the Council, Article 13.

The principles of environmental risk evaluation are described in the EU's release directive and can be summarized in the following points[67]:

- Environmental risk evaluation is performed in accordance with the precautionary principle.
- Both direct, indirect, immediate and delayed effects have to be investigated, where such direct effects refers to effects resulting from the GM plant itself, whereas indirect effects refers to effects attributable to a chain of cause and effect, including the spread of the GMO to the environment, interactions with other organisms and a change in farming practice.
- Any cumulative long-term effects must be studied.
- The environmental risk evaluation must be conducted in a transparent fashion on the basis of available scientific and technical data.
- In specific terms, each environmental risk evaluation is done on a case-by-case basis, which is to say that every new GM modified plant line must be subjected to a separate evaluation.

The Member States and the Commission further ensure that GMOs that have had genes transferred which express resistance to antibiotics used in human or veterinary medicine are accorded particular consideration during the environmental risk evaluation with an eye to phasing out antibiotic resistance markers, which can have undesirable effects on the health of humans or the environment.[68]

In order to further minimize the risk of undesirable effects occurring to human health and the environment as a result of releasing and marketing GM plants, the approval of GM plants is done in stages. This means that in order to be able to apply for permission to market a particular GMO, it needs to have been:

1. Studied in laboratories.
2. Tested under self-contained conditions in hothouses and
3. Tested in field trials.

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67 Directive 2001/18/EC of the European Parliament and of the Council, Appendix II.

68 Directive 2001/18/EC of the European Parliament and of the Council, Article 4, subs. 2.

Each stage requires discrete approval, which is partly dependent on the results achieved at the previous stage. As more becomes known about the individual GM plant, it opens the way for more contact with the surroundings.

Tracing and labelling

The Release Directive further stipulates that all GMOs constituting or forming part of products must be labelled at all stages of their marketing[69] unless the content of material consisting of or manufactured from GMOs does not exceed 0.9% and provided that the occurrence is unintentional or technically unavoidable.[70] In order to form a basis for precise labelling and monitoring of the effects of GMOs on the environment and human health, a regulation has also been passed on tracing and labelling GMOs. This stipulates that the GMOs' pathway through the production and distribution chain must be traceable.[71]

In this connection it is essential to emphasize that only products *consisting of* or *manufactured from* GMOs need be labelled. That means, for instance, that there is no requirement for meat, milk and eggs to be labelled genetically modified even if they come from animals fed with genetically modified feed.

Consultation of ethical bodies

Relevant committees can be consulted about ethical issues. Thus, under Article 29 of the EU's Deliberate Release Directive, the Commission must, at its own initiative or on the request of the European Parliament or the Council, consult all those committees it has formed to advise on the ethical aspects associated with biotechnology, such as the European Group on Ethics in Science and New Technologies, about ethical issues of a general nature.

The 9th consideration of the preamble to the EU's Deliberate Release Directive also provides scope for making allowance for the ethical aspects of releasing into the environment or marketing GM plants.

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69 Directive 2001/18/EC of the European Parliament and of the Council, Article 21.
70 Regulation No. 1829/2003 of the European Parliament and of the Council, Article 12.
71 Regulation No. 1830/2003 of the European Parliament and of the Council.

However, the status accorded to the consultations with the ethics advisory bodies is unclear, partly because no criteria have been established governing what it is, more specifically, that ethics advisory bodies are supposed to take a stance on. So although scope has been provided for consulting ethical councils, it is purely the scientific risk evaluations that form the basis for the approval of GM crops and foods. GM plants and foods can be freely marketed unless there is scientific evidence that they can have a harmful effect on human health and the environment.

The approval procedure reflects the fact that it was engineered within a legal tradition largely based on liberalist theories. It is not for the state to determine what is good for citizens—only to protect the individual from being violated. This liberal regulatory practice is not just important for trade in the EU, however—it is a mainstay of the World Trade Organization (WTO).

International agreements

WTO

The purpose of *WTO* is to develop a multilateral trading system with the objective of reducing trade and tariff barriers as well as ensuring non-discriminatory trading conditions. According to the "Most Favoured Nation" (MFN) principle, a principle of equal treatment, products from one member country must, for example, be treated at least as favourably as "corresponding products" from all other member states, whereas "the national principle" serves to ensure that imported products are treated just as favourably as "corresponding products" from the country itself.

WTO seeks to promote the internationalization of trade and is therefore reluctant to acknowledge limitations to the principle of non-discrimination. However, there are a number of exceptions to the main rule that trade barriers may not be introduced, the most central of which gives member states an opportunity to enforce measures necessary to protect the life or health of people, animals or plants.[72]

72 GATT, 1994, Article XX on general exceptions (b).

In addition, the agreement on sanitary and phytosanitary measures, called the SPS Agreement, enables states to make use of the precautionary principle. The GATT Agreement allows the preservation of non-renewable natural resources to be taken into consideration. And with the ‘Decision on Trade and Environment’, signed in 1994, WTO undertook to take on board environmental and sustainable development concerns in its continued work. What the derogations have in common, however, is that measures contrary to the principle of non-discrimination can only be legitimized when they are based on relevant scientific information.

It is a basic principle of WTO, therefore, that anyone must be free to produce, trade in, import and export industrial and agricultural goods. If scientific risk evaluations show that a particular product is harmful, member states have the option of introducing trade barriers. But the market determines what will be manufactured, not the state. The WTO agreements, then, do not make any immediate provision for incorporating a utility parameter or some other ethical consideration in the regulation of GM plants.

Since international agreements are of essential political significance, the WTO rules therefore make it difficult for the EU to take into account anything other than a narrow range of possible risks that can be tested by scientific methods.

Codex Alimentarius

However, looking at *Codex Alimentarius*, which is a joint FAO/WHO commission under the UN that attempts to formulate global food standards, there are some openings for incorporating ethical considerations when it comes to food and consumer safety.

The main point of Codex Alimentarius is to protect consumers’ health, guarantee fair-trade practice in the food industry and promote the work of drafting food standards, which is done by international, governmental and NGO organizations. The guidelines from the Codex Alimentarius Commission are recommendations and as such are only directive, therefore, not legally binding on the member states participating. Although the guidelines are recommendations only, they nevertheless have legal import because the WTO Agreement and several subagreements under WTO refer to international standards having to be complied with when settling cases concerning trade disputes in the WTO.[73] This makes Codex Alimentarius standards part of the legal framework for the food trade.

In the context of Codex Alimentarius it is repeatedly stressed that ethical concerns may be included when discussing consumer and food safety. The ethical standards open the way for creating a tradition, over time, of involving ethics on an equal footing with other aspects such as risk evaluation in the assessment of GM plants.

The Norwegian model

The principal purpose of the Norwegian Gene Technology Act is to ensure that the manufacture and application of GMOs takes place in an ethically and socially defensible manner, in accordance with the principle of sustainable development and without any detrimental effects to health or the environment.[74]

The Act sets out guidelines for the self-contained use of GMOs and the release of GMOs, imposing a number of obligations on GMO producers: duty of disclosure to public authorities, duty to avert and contain hazards in the event of the accidental escape of GMOs in the open and liability in damages, which is liability in damages irrespective of own culpability (objective liability) if the company causes damage, inconvenience or loss as a result of its release or discharge. The Act provides scope for imposing default fines, and imposing fines and imprisonment for up to one year for intentional infringement of the law, and under aggravating circumstances up to four years' imprisonment.

The interesting thing about the Norwegian Act is that, unlike the laws of most other countries, it includes sustainability and social utility as criteria that have to be met in order for approval to be granted under the Act. In a memorandum on biotechnology in the UK, the USA,

73 According to information from the Danish Veterinary and Food Administration (the national focal point for Codex Alimentarius). See the SPS Agreement, inter alia.

74 Norwegian Act 1993-04-2 No. 38: Act on the Production and Use of Genetically Modified Organisms etc. (Gene Technology Act).

Germany and Norway, it thus emerges that the legislative history of the Norwegian Gene Technology Act contains a number of deliberations as to which ethical principles should be applied in connection with the approval procedure for GMOs:

"On the prelegislative committee there was … 'broad consensus concerning the need to subject biotechnology to a *social utility* requirement. This concept was criticized by the many consultation partners involved with the bill, inter alia on the grounds of being incapable of allowing for the value of pure research, being imprecise and thus non-operational (Aachen, 1997)' ".[75]

The concept now features in the Norwegian Gene Technology Act, Section 10, which states that importance is attached to the release of GMOs "being of social utility value and being suitable for promoting sustainable development".[76] Another interesting aspect of the Norwegian legislation is that the Norwegian Biotechnology Advisory Board has to submit statements on specific cases relating to the Gene Technology Act and issues of biotechnology.[77] That means that the Biotechnology Advisory Board is a regular consultation partner and deals with each individual application with a view to clarifying whether it complies with the requirements of sustainability and social usefulness.

The Biotechnology Advisory Board is made up of 21 people from relevant ministries and special-interest organizations. It is a consultative and independent body for government services, specifically tasked with evaluating and discussing matters of general interest or policy connected with biotechnology and genetic engineering, including social and ethical issues.

In its report entitled 'Sustainability, Benefit to the Community and Ethics—in the assessment of genetically modified organisms' the Biotechnology Board attempts to clarify how the concepts in Section 10 of the Gene Technology Act are to be interpreted, and concludes

75 Coff, 1998, Bioteknologipolitik i England, USA, Tyskland og Norge.

76 Norwegian Act 1993-04-2 No. 38: Act on the Production and Use of Genetically Modified Organisms etc.

77 Norwegian Act 1993-04-2 No. 38: Act on the Production and Use of Genetically Modified Organisms etc., Chapter 5, Section 26.

that the social utility and/or sustainable development criteria can be used both to weigh up any potential risk and to dismiss an application if the social utility and/or sustainable development requirements have not been met.[78] According to the Biotechnology Advisory Board, therefore, an application can be dismissed purely on the basis of failing to comply with the social utility and/or sustainability criterion, even though the GMO is deemed to entail only a negligible risk.

An example of this can be seen in the Biotechnology Board's final consideration of the genetically modified maize C/DE/02/9, line MON863, from Monsanto, which has been rendered insect-resistant. With the exception of a single member the Biotechnology Board refuses to approve the maize line until documentation has been provided to show that its use will have a socially beneficial effect and/or contribute to socially useful development. The Board stresses that, in theory, growing MON863 may result in reduced pesticide consumption, but focuses on the balance of probabilities being stacked against this according to the applicant, and on the lack of synoptical analyses in existence to show that pesticide consumption is actually cut in regions where the GM plants are grown.[79] During the first eight months of 2006 the Norwegian Biotechnology Board dealt with five cases.

Considerations of utility within other areas of legislation

Medicines legislation

According to the Danish Medicinal Products Act and European Parliament and Council Directive 2001/83/EC a medicinal product or drug must have a documented therapeutic effect in order for marketing authorization to be issued.[80] And there must be a favourable correlation between the benefits and the risks of the drug.[81] Thus the beneficial effect of a drug in relation to the disease it

78 Rogne, 2000, Sustainability, Benefit to the Community and Ethics—in the assessment of genetically modified organisms: Implementation of the concepts set out in Sections 1 and 10 of the Norwegian Gene Technology Act.

79 Norwegian Biotechnology Advisory Board, 2006, Final Consideration of Genetically Modified Corn C/DE/02/9, line MON863 from Monsanto.

80 Danish Medicinal Products Act, Consolidation Act No. 1180 of 12/12/2005, Section 12, and Directive 2001/83/EC of the European Parliament and of the Council, Article 26, b).

81 Danish Medicinal Products Act, Consolidation Act No. 1180 of 12/12/2005, Section 8.

aims to treat is crucial to its ability to be approved. It cannot be inferred from this that a dedicated utility parameter is included in drug regulation, however, in the sense that a drug, in order to qualify for approval, must contribute to maximizing general welfare in society. Amongst other things, the legislation does not stipulate requirements that a new drug must function better (or equally well) or have a more favourable (or equally favourable) correlation between benefits and risks than pre-existing drugs that aim to achieve an equivalent therapeutic effect.

The Medicinal Products Act defines a drug as "… any item presented as a suitable means of treating or preventing diseases in humans …"[82], whereas in the EU Directive a drug is defined as "any substance or combination of substances presented for treating or preventing disease in human beings [or animals]."[83] In light of the fact that the legislation includes only articles *marketed* as having a therapeutic effect, the stipulation regarding a documented therapeutic effect should probably only be seen as a way of protecting citizens from "misleading drug advertisements and other illegal marketing of drugs"[84], as also stated in the preamble to the Medicinal Products Act.

Chemicals legislation

Nowadays all chemical substances can be freely used unless the authorities have demonstrated a risk associated with the individual substance and have therefore banned its use. However, with the EU's new agreement on the registration, evaluation and authorization of chemicals—the so-called REACH[85] Agreement, signed on 13 December 2005 at the EU's Competitiveness Council—it will be up to

82 Danish Medicinal Products Act, Consolidation Act No. 1180 of 12/12/2005, Section 2.

83 Directive 2001/83/EC of the European Parliament and of the Council, 2001/83/EC, Articles 1, sub. 2).

84 Danish Medicinal Products Act, Consolidation Act No. 1180 of 12/12/2005, Section 1.

85 REACH stands for: R = registration. Companies must state which chemicals they are manufacturing or using, what they intend using them for and how they intend to label them. E = evaluation. Companies must evaluate the information for problematic chemicals and for chemicals of which they produce more than 100 tonnes a year. A = authorization or approval of more narrowly defined particularly problematic substances. The authorities must grant a licence before companies are allowed to use the particularly problematic substances, and companies must prove that it is safe to use them. CH = chemicals.

the industry to show that it is manufacturing and using chemicals properly in future.

REACH will establish that chemicals legislation in the EU is based on the precautionary principle. Thus the use of particularly problematic substances will require approval, whereas today there is no approval scheme for industrial chemicals; also, a new feature will be that an analysis of possible alternatives must always be made available, and the most hazardous substances must be substituted if suitable alternative substances or technologies are available.[86]

However, the interesting thing is that within the field of chemicals there is acceptance that problematic substances can be used; that is to say, substances that pose a special risk to human health or the environment if the social (socioeconomic) benefits offset the risk to health and the environment. The legislation does not specify how it is wished to gauge the social benefits, but the Act does open the way for the inclusion of a utility parameter—not as a self-contained constituent, but in the event of the utility value being regarded as sufficiently great to offset the detrimental effects of using a particular chemical.

The possibility of incorporating ethical considerations in international terms

One way forward towards an acknowledgement of ethical considerations might be to link them to the environment and sustainability considerations already mentioned in the WTO agreement, and to endow the ethical principles with sufficient content and universality to have them respected without being classed as tantamount to local trade barriers.

If it is wished to forge common ethical standards for the purpose of regulating GM plants, however, it is essential to remember that the various member states of the WTO take a very different view of GM plants, and it can therefore be difficult to align along a common axis

86 See the Danish Ministry of the Environment's review of the EU's draft of the new chemicals legislation REACH: http://www.mst.dk/default.asp?Sub=http://www.mst.dk/kemi/02000000.htm

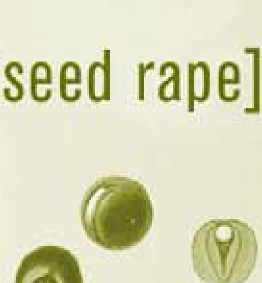
around a set of ethical principles or merely to agree on the relevance of talking about ethical principles in this connection.

In particular, the EU and the USA take different views of GM plants. While the EU has adopted a highly restrictive approach, particularly as regards the release of GM plants, the American view is that GM products do not differ in any basic respect from other products. If there turn out to be no significant inadvertent undesirable effects following risk evaluation of a particular GM plant, it will therefore be deregulated in the USA, one of the implications being that it need not be monitored or handled in any special way during distribution or release onto the land. Actual genetic engineering and its use in agriculture and food production are not, therefore, considered to involve any special risks or necessitate ethical deliberations. This is also why the USA has not signed the Cartagena Protocol on Biosafety, whose purpose is to safeguard a suitable level of protection in connection with the cross-frontier transfer, handling and use of living modified organisms (LMO).[87]

If the EU stipulates that the release of GM plants has to satisfy special ethical standards or contribute particular social utility, the EU will therefore end up on a collision course with the USA, as happened before when the USA, during the EU moratorium on the approval of GMOs, accused the EU of having no legal basis for banning the import of GM crops as long as risk evaluations were unable to prove that GM crops were harmful.

87 The Cartagena Protocol on Biosafety, 2003, Article 1. The Cartagena Protocol is an offshoot of the 1992 UN Convention on Biodiversity. The purpose of the protocol is partly to protect the public from the possible health risks of GMOs. The protocol lays down rules governing international trade in GMOs, and includes rules on risk evaluation and risk management, with a view to protecting human health. The protocol also contains rules about labelling, handling, transportation, packing and identification. The protocol came into effect in 2003 and 132 countries have ratified it at the present time. An international agreement with labelling requirements for GMOs bound for export was adopted on 17 March 2006 at the third meeting under the so-called Cartagena Protocol on Biosafety. The agreement sets forth minimum rules for documentation of GM agricultural goods to be used for consumption, feedstuffs or in processed foods.

[oilseed rape]



Utility assessments

As described above, it is now virtually exclusively the outcome of the scientific risk evaluation that decides whether a genetically modified plant may be released or marketed. However, it does appear obvious that risk is merely one of several components that should be included in evaluating the overall reasonableness of releasing or marketing a particular GM plant. Including utility in the evaluation seems particularly obvious.

In the studies conducted into the Danes' and the Europeans' attitude towards the use of GMOs in general, the beneficial effect of GMOs plays an essential part.[88]

Studies thus show that there is not so much scepticism concerning the application of genetic engineering when it comes to areas like medicine or has to do with reducing famine. But if it is merely about endowing tomatoes with slightly longer shelf-life or making the already highly efficient production of food even more efficient, genetic engineering is not acceptable to the population at large. This difference can be explained in part by the fact that the former application is regarded as more useful than the latter.

But scepticism in relation to using GMOs in the food domain has to do with other factors as well. Among other things, many citizens feel that large multinational companies are primarily reaping the benefits of

88 See e.g. Lassen et al., 2003, *Mere end risiko – om danskernes holdning til genteknologien.* For a brief overview, see also Special Eurobarometer, 2005, Social Values, Science and Technology, and Eurobarometer 64.3, 2006, Europeans and Biotechnology in 2005: Patterns and Trends.

using GM crops, to which they object. Similarly, more and more people are turning against the restriction of consumers' freedom of action which they feel the development will eventually bring about as a result of monopolistic states within the area. Finally, some citizens regard the use of GMOs as being contrary to the natural order of things, and for this and other reasons will go to great lengths to retain the chance of buying exclusively organic goods. As an extension of this, many people also object to the use of GMOs to boost production or to counter environmental problems. Instead, it is pointed out that existing forms of production are already efficient enough and, if anything, should be reorganized rather than improved through the use of GMOs. Considerations of risk, on the other hand, do not play a crucial part for many citizens—or if they do, at any rate, such considerations primarily concern the long-term consequences of using the techniques, taking a critical view of the experts' ability to predict these.

It should be noted that there are substantial differences in attitude between the European countries in a number of areas, both in individual countries and between countries. In response to a question about the extent to which people advocate developing GMOs that can be used to decontaminate the environment in the wake of disasters, 47% of the respondents in Malta said "in all cases", whereas the corresponding figure in Finland and France was only 9%.[89] In other areas, though, studies show many points of similarity between the individual countries. For example, on the topic of support for GM foods, Eurobarometer poll 64.3 from May 2006 concludes that:

"With a few exceptions, among the former EU15 countries we see the tendency of a steady decline in support between 1996 and 1999, an increase between 1999 and 2002, and a return to a decline in support in 2005. The decline between 2002 and 2005 is striking; in many countries levels of support drop below those reported in 1996". [90]

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89 Figures taken from *Social Values, Science and Technology*, Special Eurobarometer, June 2005.

90 Eurobarometer 64.3, 2006, p. 21.

Similarly, on the back of one study, it is stated that there is a conspicuous lack of backing for GM foods in all countries compared to nanotechnology, gene therapy and pharmacogenetics[91]:

"The striking feature of the chart is the low level of support for GM food, relative to the other applications. Even in Spain, where tens of thousands of hectares have been planted with GM crops, support is only 7 per cent above the European average of 27 per cent. The introduction of the new regulations on the commercialization of GM crops and the labelling of GM food (2001/18/EC) appears to have done little to allay the European public's anxieties about agrifood biotechnology".[92]

Although it may seem only natural to incorporate utility assessments when approving GMOs, it nonetheless involves a number of difficulties. This is partly to do with the fact that utility assessments are always based on values, without necessarily having any agreement as to which values to base the utility assessments on. In that sense, utility assessments constitute a subjective component, as will be seen in the following section.

On the concept of utility

Focusing on a specific genetic engineering application, it will be seen to have a large number of consequences, some of which will be useful or good as seen from a normal perspective and appreciation, whereas others might be regarded as bad. For any given technology it is possible to make a list of the anticipated useful or good consequences and the anticipated bad ones. For example, whether the technology will be instrumental in improving the environment, or whether there is a risk of it reducing biological variation and diversity.

Yet any enquiry about the concept of utility in a philosophical or financial context is actually an enquiry about the nature of utility *as such*. The enquiry does not ask for a list of good and bad consequences here; instead, it elicits what it is about the various good consequences on the list that makes them good; or, by the same token, asks by virtue of what the bad consequences are bad?

91 Pharmacogenetics involves analysing the individual's genes with a view to medicating more effectively.

92 Eurobarometer 64.3, 2006, p. 21.

The concept of utility has been defined and developed in a philosophical and financial context. Here the concept forms part of different theories that can inform the debate on the release of GM plants. Some relevant descriptions of utility will be accounted for below. Later on, the descriptions will be linked with the more general ethical, political and economic theories to which they lead on.

Utility understood as happiness or quality of life

The most straightforward answer to what it means for something to have useful or good consequences is that it contributes to making people's lives better.[93] Useful, then, is whatever contributes to human happiness, whereas bad is whatever makes people's lives worse; but this answer is not particularly illuminating unless something more precise can be said about what contributes to human happiness or human quality of life. In the modern debate on quality of life and happiness, however, this is highlighted as being particularly difficult, owing to several factors:

People have a variety of different wishes and goals in life

The individual person's happiness is presumed to depend on whether they have their wishes fulfilled and goals achieved. Yet it is a fact that people have very different, simultaneously and often mutually conflicting desires and goals for their life. Enjoying a high standard of living may be a goal. As a basic starting point, therefore, it may be considered a good idea to develop GM plants that have been rendered resistant to attacks from pests and are tolerant to some types of herbicide. This may possibly make production more efficient, thereby creating cheaper food and maybe even more space for "unspoilt" countryside. But at the same time, emphasis is attached to conserving nature, which advocates caution in modifying existing species or reducing natural diversity. In addition, value is ascribed to supporting the developing countries, providing a clean environment for the benefit of everyone and generally taking responsibility for the state of the globe.

93 For the sake of clarity, utility is discussed from a perspective below, in which it deals with *human* happiness, but from a more comprehensive ethical angle animal welfare or happiness are also relevant.

These quite disparate wishes and goals have caused philosophers and economists to claim that quality of life and happiness are subjective, in the sense that one can neither posit universally applicable standards for a good life nor assume that any consensus can be achieved around introducing new technology, for example. In principle, all that can be said is that the individual's quality of life depends on the wishes and objectives they nurture in relation to life. This fundamental truth, however, does not preclude the possibility of attaining a high degree of consensus in a population concerning some matters. There are indications that this is actually the case in connection with GM plants. Thus studies have shown that a majority of Europeans are opposed to using GM plants, partly because consumers are unable to see the advantages, and because the plants are marketed by powerful multinational enterprises that limit the consumer's alternative scope for consumption.[94]

Wishes are often based on different types of values and are therefore incomparable

If it were possible, by *comparing* the relevant wishes in a particular situation, to determine which ones it would be most correct or most appropriate to grant, the fact that people have different desires in life would be less problematic. One problem in this context, however, is that the relevant wishes are often incomparable because they are based on different types of values. For example, it is difficult to compare the wish to achieve a higher level of consumption with the wish to preserve existing species in their present form. The first wish is, in a very direct sense, about human welfare, whereas the second refers more to an ethical value. In this sense it is a question of comparing the height of Big Ben with the height of a thunderclap: the yardsticks used for measuring are completely different, quite simply. The value most expedient to use as a baseline cannot be decided by actual deliberation or comparison, therefore, because the values cannot be weighed on the same scales.

94 Lassen et al., 2003, *Mere end risiko – om danskernes holdning til genteknologien.*

Different perspectives on utility

Comparing the deliberations voiced by Danish citizens and other Europeans with those that have commanded centre stage at international negotiations, essential differences begin to emerge clearly. In an international context the problem has chiefly revolved around implementing free trade versus the possibilities of conducting adequate scientific risk evaluations.[95] Conversely, neither considerations of utility nor assessments of GM plants' altogether fundamental justification have enjoyed the same centre-stage position as in the popular debate. Domestic political debate also seems to have focused mainly on topics such as risk evaluation, liberal trade and consumer rights (including adequate food labelling), whereas assessments of the usefulness of GMOs have not played the same role to date.

However, it is important to realize that utility assessments can take very different forms, depending on the perspective adopted. From individuals' perspective something may seem useful, while at the same time it does not look useful or beneficial from an overall point of view, and vice versa. For that reason alone it is important to be aware that including a utility perspective will open the way for questioning just whose perspective is to be decisive.

A similar argument can be cited for risk evaluations, which can be regarded as a kind of utility assessment in reverse, because they deal with what has negative utility. Studies show that so-called "risk perception" depends on complicated conditions. Whether, say, GM crops are considered risky is not merely a question of the statistical likelihood of a negative outcome like disease, death or environmental destruction occurring:

"It matters whether or not the risk is 'natural' or imposed through uniquely human interventions in the food production chain. It matters whether or not there is an opportunity for personal control. In the case of an imposed risk with no room for personal control, it also matters whether the disease is invariably fatal and very dreadful".[96]

95 Winickoff et al., 2005, Adjudicating the GM Food Wars: Science, Risk, and Democracy in World Trade Law.

96 Jensen, 2006, Conflict over risk in food production: A challenge for democracy.

Seen from an overarching planning perspective, however, it may be tempting to ignore these considerations, basing planning on whatever produces the fewest negative outcomes, statistically speaking. If, for instance, the statistical likelihood of disease, death or environmental destruction is deemed to be smaller from using a specific GM crop than from using a corresponding traditional crop, the former is preferable, regardless of it being perceived among the population as riskier.

If systematic disagreements exist about the values and parameters on which GM crops are to be assessed, the question of how to handle this problem will necessarily have to be asked. As many debaters have stated, such disagreement may initially necessitate an open dialogue in which the various points of view are identified and clarified relative to one another. Such dialogue is necessary as part of a democratic legitimization of the decision that will ultimately be made.

Another consequence might be that the international community would refrain from allowing strictly scientific risk evaluations to form the basis for assessments of the restrictions on trade, opening the way instead for the individual countries in certain cases to forbear from accepting the introduction of particular GMOs for value-based reasons. Doing so, however, does not avoid the need to resolve the fundamental problem of determining which values and parameters to use as a basis for the final decision.

It should be noted that risk evaluations also include subjective components, for precisely the same reasons as utility assessments. This is because risk evaluations concern possible negative consequences of the initiatives being considered, but there is no certainty that there will be agreement as to what counts as negative consequences. For example, there may be disagreement about whether it should be regarded as a problem per se that developing GM plants can lead to increased patenting. Given the way risk evaluations on GM plants are conducted in practice, this problem has been partly ignored, because the findings are confined to the risk to the environment and human health, and there is not nearly as much disagreement over these parameters. That does not alter the fact that not including the risk of creating inappropriate forms of farming production or promoting monopolization in risk evaluations is a value-based and potentially disputed decision.

Utility and satisfaction of basic human needs

As shown, basing utility assessments on a description of human happiness or quality of life can be problematic. Instead, one possibility is to take as a basis certain more objective attributes of human life, such as a description of mankind's basic needs. The initial intention would be to create greater clarity around the actual nature of utility, but at first sight it appears to be more plausible for another reason too. If utility assessments are to be included in the political ambit and form the basis for assessing new technologies or products, then it is only reasonable to ask whether it is really the legislators' task to promote the individual's quality of life or happiness. One obvious answer is that this is the individual's own task, if anything. The legislators cannot be obliged to make anything more than a contribution towards satisfying the individual's most fundamental needs, such as the need for health services, education, a place to live, resources for living a more or less normal life, and for averting accidents. If the individual subsequently manages to make a success of life, a large part of the credit must be down to the individual's own responsibility.

The idea that it is primarily the state's job to help satisfy citizens' most fundamental needs is entrenched in many ethical and political philosophies. Within these theories it has been attempted to provide a definition or description of fundamental needs that may be conducive to clarifying the state's obligations vis-à-vis citizens. One example of such a definition is David Braybrooke's, according to which something counts as a fundamental need when it is necessary in order to "live or function normally". This wording is expounded more specifically in this way:

"The criterion [for a course-of-life need] is being indispensable to mind or body in performing the tasks assigned a given person under a combination of basic social roles, namely the roles of parent, householder, worker, and citizen." [97]

97 Braybrooke, 1987: *Meeting Needs*, Princeton University Press, pp. 31 and 48.

Basic needs, then, according to this author, are the need for food, rest, company, social acceptance, personal safety, education and so on.

Many other divergent definitions of fundamental needs exist, but what they all have in common is that they are not particularly precise. It is virtually always possible to ask how comprehensive a task it is, more precisely, to satisfy the individual's needs, i.e. how much education and resourcing etc. the person needs, more specifically. More often than not, the definitions are not objective, either, in the sense that the individual's needs are dependent on the society in which it finds itself. On the contrary, the concept of need is largely bound up with the standards of acceptable life conduct that already exist in any given society. This may be thought to pose a problem in terms of definitions, but on the other hand people are normally perceived as social beings, with a distinct need to be card-carrying, active members of society. From this perspective the concept of need will inescapably be relative to the specific society in question.

Moreover, it should be noted that, as they are defined above, the satisfaction of needs normally cause an immense amount of utility, as compared with the utility associated with satisfying preferences in a broad sense. This is precisely because needs flag the altogether basic *prerequisites* for living a life in which it is possible to take part in society in the normal way and gain the self-respect and self-confidence that result from doing so.

As shown by the aforementioned population surveys, it may be feasible to establish some consensus in a Danish context to develop and apply GMOs that can be used to satisfy fundamental human needs. For example, as mentioned, it is already generally acceptable to use genetic engineering to combat hereditary diseases or remedy different nutritional problems if they cannot be remedied by other means without considerable cost. In other countries—the USA, for example—the attitude towards GMOs is less critical than in Denmark, but it might be worth trying to achieve international agreement on making research and use possible, primarily, with an eye to satisfying fundamental human needs and/or creating sustainable development.

The concept of utility in ethics

As pointed out above, including utility assessments in ethical position-taking is not such a simple affair, one reason being that people have different views and perceptions of what is useful. Another matter that can complicate things further is whether the individual person's perception of what is useful or useless should always be taken at face value. It is a well-known fact, after all, that the individual can not only mistake what is beneficial for him/herself but also what is useful for society as a whole. Whether to attempt to correct for this scope for error in the way the concept of utility is actually included in ethical theory therefore remains an open-ended question. For example, some people have proposed that the individual's *actual* assessments should not be used to form the basis for ethics, but on the contrary the evaluations that the person concerned *would* have had, had he/she been fully informed. But in that case, of course, the question is just who is going to determine what the individual would have thought under those circumstances. Others have suggested that the individual's own utility assessments not be taken as a basis at all, but that more objective criteria be used as a basis for utility instead, taking the concept of need (compare earlier), for instance, or relating to how a particular action or measure affects the resources and opportunities of those involved on a broader scale. But these proposals are not without their problems either. How, for example, to gauge how essential it may be considered to have the opportunity to shop organic?

A completely different question is whether the concept of utility even has or ought to have a central position within ethics. This has been discussed in philosophy for many hundreds of years without any consensus having been reached. Some will point out that our ethical concepts deal with a great many considerations that have nothing to do with utility. For instance, we often refer to principles by which people are obliged to live, irrespective of whether doing so is thought to have good or bad consequences. One such principle might be that one should try to save individual species, even though there is no general thought of benefiting from such action in the grand scheme of things. Similarly, we take it as read that the individual has rights—for example, an extensive right of self-determination—although it is not always obvious whether respecting those rights benefits the actual individual or society as a whole.

Examples like these suggest that the concept of utility is not the only or the most central ethical concept. But one can attempt, among other things, to defend the central importance of the concept of utility by arguing that the examples cited of other types of ethical consideration presumably only enjoy universal acceptance because conforming to them generally has beneficial consequences ultimately. From this point of view, then, principles and rights should be perceived primarily as aids to achieving greater utility. There is no doubt, however, that those who lend their support to various principles and rights do not view such principles as merely being a means to achieving utility. They will feel that rights and principles have to be respected in some cases, whatever the consequences.

Distributional problems

As seen from the above, considerations of utility form an essential constituent of ethics. But there are also ethical concerns to take a stance on in connection with GM plants other than consideration for the quality of life of the existing Danish population. Some of these considerations will be described in the following.

Future generations

One essential problem is whether to allow for the way in which utility and risk are distributed, both in relation to the existing population and in relation to future populations/generations. Assuming one adopts the view that there is no justification for taking less account of future populations than present ones, it is just as important, ethically speaking, for future populations to have an opportunity to enjoy a good life as present populations. Based on this consideration, then, considerations of utility can be used to justify the tenet of *sustainability*, which in principle refers to systems' ability to maintain themselves. In the Brundtland Commission's report on the environment and development, sustainable development is defined thus: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[98] How to construe the sustainability principle in practice, however, is controversial. This ties in with the difficulty of describing which needs future generations are entitled to have met, more precisely. One may ask, for example, whether future populations are entitled to be able to experience roughly the same variation of species, both in the wild and on cultivated land, as those accessible to present populations, or whether it is sufficient to preserve them in some form or other so that their acquaintance can

98 The Brundtland Commission, 1987, Our Common Future – The Brundtland Commission's report on the environment and development.

be made either at special locations in the wild or at botanical gardens or similar sites? In practice it makes a huge difference which of these interpretations of the need to be able to experience varied natural amenities is endorsed.

The fuzzy nature of future generations' entitlements under the mantra of the sustainability principle does not mean, however, that the principle cannot serve any real purpose in practice. On the contrary, this lack of clarity should arguably be incorporated in the actual application of the principle. It can be stated, for example, that the development and use of GMOs should under no circumstances leave future generations worse off than they would otherwise have been. On the basis of such an interpretation, the corollary of the sustainability principle is that GM plant use should be based on the precautionary principle, since any adverse side-effects will be irreversible and may therefore end up impacting on future generations. According to this line of thought, therefore, GM plants should not be taken into service unless there is very great certainty that their release will have no material negative and irreversible knock-on effects. The dilemma, however, is that by denying permission for a particular GM plant, groups of people and natural resorts may ultimately be deprived of a number of benefits and enhancements.

In a wider perspective it may be said that the sustainability requirement should form the basis of all economic and social development, whether developed or undeveloped countries, countries of the east or the west are involved—or whatever, because from an ethical standpoint one might claim that future individuals should be acknowledged as being valuable on a par with present ones. The extent to which the sustainability requirement also involves acknowledging that *nature* has value in its own right is more debatable, but the concept of sustainability is consistent with this assumption, which seems to lend additional gravitas to the concept of sustainability.

Based on some views, the idea of sustainability can be linked to a distrust of natural-scientific theories and methods—or to the application of the theories on which GM plant development and implementation is predicated by the conglomerates.[99] According to this school of thought genetic modification is not merely a technology. Genetic modification is part of a culture that is committed to growth and production of scientific know-how, and as such is in contrast and opposition to more locally anchored practices, constructed to a greater extent around handed-down experience and the exchange of knowledge, goods and services in decentralized networks. According to adherents of this view, science-based and technological farming basically poses a greater threat to sustainability than experience-based and more locally anchored practices, partly because the application of natural-science theories sometimes allows attributes of reality to be disregarded that some people would consider essential.

Who stands to benefit from the technology?

Most people can probably endorse the principle of sustainability in some form or other. Conversely, it is certainly more controversial whether specific requirements should be attached to who should benefit from taking new technology into service.

From one point of view the introduction of new technologies should benefit primarily those who are worst-off. That is to say that, first and foremost, the researching and application of GM plants should benefit people with unmet needs, for example people with serious disorders or nutritional problems. The philosophy can thus be used as justification for developing and using medicine or GM plants to combat nutritional problems in the developing countries.

A recurring theme in the debate is that genetic engineering is not acceptable if it serves merely to boost growers' and manufacturers' profits. The population studies show that part of the widespread scepticism towards the use of GM plants is based precisely on a notion that, in practice, this will merely increase profits on the part of some large multinational companies. Based on considerations of utility, it is not a problem, prima facie, that the multinationals profit from their efforts. On the contrary, considerations of utility can be used to advocate a relatively free market, because there is a link

99 Compare Kamara and Coff, 2006, GMOs and Sustainability: Contested Visions, Routes and Drivers.

between something being profitable and being useful. That link depends on two relatively controversial assumptions: (1) People are generally interested in their lives being made better, which means that they are interested in purchasing goods or services that will make their lives better. The greater the improvement, the higher the price they are willing to pay. (2) People in general are also relatively good at working out whether goods and services actually make their lives better. Given these two assumptions, there is no discrepancy or contradiction between making a profit and creating something that benefits people, since the profitable will generally be useful. The fact that an article is profitable merely says it can be sold on a market at a higher price than it costs to produce it. The fact that it can be sold means that some people prefer this article to the alternatives, provided there are genuine alternatives, on the market. For consumers who prefer a particular article, it will therefore generally be true, given (1) and (2), that the article makes their lives better.

There are a number of very important exceptions and reservations in respect of this, however. For example, the production of goods or services can have an influence on other types of goods like clean water or natural variation, which are not marketed to the same degree. So although there is a demand for a good, manufacturing it may be at odds with mankind's interests in the longer term. By the same token, of course, the product can have an adverse effect on future generations or animals without having any great impact on demand.

Although the consideration of utility can be used to justify a relatively free market in some contexts, in others it can also be used as an argument for making a special effort in terms of those who are worst-off. This has to do with the fact that it often takes less effort to enhance the quality of life for those who are badly off than to enhance the quality of life for those who are well off. More particularly, therefore, the theory will advocate nurturing the basic human needs which the individual him/herself cannot afford to have met as a player on the market.

Ecocentrism

In the debate on genetically modified plants many people have referred to a conception of nature that is claimed to either justify or problematize the production and application of plants. In this and the following chapter some of these conceptions of nature will be described. This chapter describes the ecocentric view and goes on to outline different religions' view of nature.

The ecocentric philosophy has played an essential part both in the debate on GM plants and in the environmental debate more generally. According to ecocentrism, entities like species and ecosystems have independent ethical status. As a result, every effort must be made to cherish and protect these entities, not merely out of consideration for individual people or animals but because the entities have an *independent* value. If the use of GMOs poses a threat to the continued existence of these entities, there is basically good reason to be sceptical, therefore.

Large parts of general ethics are either anthropocentric or biocentric; that is to say that either consideration for people or more generally consideration for *single* living individuals is ascribed crucial importance in an ethical context. The attempted justification for the existence of ethical considerations for people and animals only is often that only individual people or animals have mental experiences and are therefore capable of feeling joy or pain. How the individuals are treated is not immaterial, therefore, because it affects their welfare or quality of life. It has also been claimed that other types of individuals like trees and plants may be entitled to be accorded consideration. Among other things, the opinion has been that there is a natural way for a plant to develop, which must be respected.

An essential justification for according entities like species or ecosystems etc. ethical status as well is that these entities have subject status just as much as, if not more so than, individuals. The philosophy can be justified, for example, by arguing that the individual within a species is relatively insignificant, from a biological evolutionary perspective. Rather, in the great scheme of things, it is the individual species and their development that are essential, and seen in this light the individual is merely a means of perpetuating and possibly even evolving the species.

As has been seen, then, the view includes a criticism of traditional individualism, in which individuals alone are ascribed ethical status. It is often asserted that the consequence of this point of view is that the primary focus for ethical deliberations must be process oriented:

"The goal of conservation should be to preserve and protect natural processes. We need to stop thinking parochially about static unities as if they were the building blocks of nature. Instead, we need to consider processes that shape the diversity of life on this planet, including our own lives".[100]

In this sense the ethics developed in the process can be said to accommodate respect for the creative powers of nature:

"Some of us call the creative drive of ecological systems 'autopoiesis' (from the Greek: 'self-making') – it is a mysterious driving force that creates, through dissipation of energy in open systems, a kind of growth or development, as order is created out of chaos".[101]

On the basis of such a biocentric view, it will be fundamentally problematic to use genetic engineering to modify the individual species, because the changes involved could not have taken place naturally. In that sense nature's own creative powers are not respected. And if use of the technology further entails a diminution in ecosystems' natural ability to function—for example, because some reduction in biodiversity takes place—it will naturally render that use even more problematic.

100 Vrijenhoek, 1995, Natural Processes, Individuals, and Units of Conservation.
101 Norton, 1995, A Broader Look at Animal Stewardship.

Yet ecocentrism may not lead to such clear-cut conclusions as might at first sight be supposed. The essence of ecocentrism is that the natural processes and the biodiversity ineluctably resulting from these processes, assuming they take place undisturbed, must be nurtured and cherished. But many of the issues on which a stance has to be formulated in the environmental field arise precisely because the natural processes have long since been disabled already as a result of mankind's activities. This applies not least within farming, and in such contexts it is not necessarily particularly instructive to refer to the way in which the process would have progressed or will progress in future without any kind of intervention by mankind. For example, it is not obvious whether, as an adherent of ecocentrism, one has to accept genetic modification of plants if it can contribute to improving the environment and the only real-term alternative would be an increase in the use of pesticides in farming.

Ecocentrism has many similarities with "*deep ecology*", which was developed by the Norwegian philosopher Arne Næss. For deep ecology, an essential point is that man must be understood as a subject whose existence and identity are quintessentially constituted by nature or the surrounding world. Accordingly, the claim is that man can only realize himself and prosper if he treats nature respectfully by allowing the natural processes to play out largely in keeping with their own objectives and logic. However, it is essential to be aware that the idea of *self-realization* should on no account be understood against a traditionalist backdrop in which man, as a well-defined subject, is opposed to nature as the object. If this were the basic premiss, treating nature with respect would be a mere means of achieving personal satisfaction, and the view could be described as anthropocentric.
For deep ecology the idea of self-realization, for example, can be the result of a cognitive process in which the individual reflects on his or her own connectedness with the rest of the universe. Such awareness can arise through, amongst other things, meditation:

"He whose self is harmonized by yoga seeth the Self abiding in all beings and all beings in Self; everywhere he sees the same. … Through identification, higher level unity is experienced: from identifying with 'one's nearest' higher unities are created through circles of friends, local communities, tribes, compatriots, races, humanity, life, and ultimately, as articulated by religious and philosophic leaders, unity with the supreme whole, the 'world' in a broader and deeper sense than usual…". [102]

As hinted at in the quotation, the description of the existential unity of all things and of the relational nature of the individual self's or the individual thing's identity finds support in some of the great eastern religions, including the different branches of Buddhism (for which, see later).

The crucial difference between ecocentrism/deep ecology and anthropocentrism/biocentrism, as mentioned, is that only the former theories regard nature as having intrinsic value, i.e. value per se, independently of whether man or other beings ascribe it value. Anthropocentric and biocentric theories, on the other hand, can only ascribe instrumental value to nature, i.e. value in terms of whether it can benefit man and possibly other beings. From an instrumental perception of nature, however, it is also perfectly arguable that the natural processes should be largely maintained, because man's well-being and existence depend on functional ecosystems.

102 Næss, 1985, Identification as a Source of Deep Ecological Attitudes.

Religious views

The following is devoted to a discussion of the conceptions of nature that can possibly be derived from four different religions with a view to identifying whether the religions point the way to a particular attitude towards genetically modified plants. The four religions are Christianity, Islam, Hinduism and Buddhism, the four most widespread religions. It might also have been relevant to study other religions and neoreligious movements, but dealing with them all would have been an insurmountable task, and the Council's chief desire has been to present some altogether key ways of conceptually fusing religion with views on nature.

A trait common to these religions is that they formulate and legitimize binding relationships, into which the individual is variously interposed in relation to his fellow man, society and hence also nature and man's place in it.

It is worth adding that providing an adequate and subtly detailed description of the four religions' conception of nature has by no means proved feasible. This is not due purely to considerations of space, but also has to do with the individual religions being open to multiple interpretations and including different branches, as well as the sometimes great distance between the orthodox religious view and religious practice. The following representations merely provide some broad brushstrokes of the individual religions and are to be taken with much reservation. The accounts are based to a great extent on J.B. Callicott's survey work *Earth's Insight.*[103]

103 Callicott, 1994, Earth's Insights, University of California Press.

Christianity

The New Testament gives no practical and specific indications as to how to view secular issues, which also includes GMO issues, of course. According to John Passmore,[104] however, the western world's view of nature has largely taken its cue from the Old Testament notion that "As man is made for the sake of God, namely that he may serve Him, so is the world made for the sake of man, that it may serve him".[105] The view can be said, for example, to build on the creation account in Genesis, Chapter 1, where God, having created mankind in His own image, as man and woman, tells them:

"Be fruitful and multiply and fill the earth and subdue it and have dominion over the fish of the sea and over the birds of the heavens and over every living thing that moves on the earth" (1:28).

However, the Old Testament approach to nature is not just one of dominion and utility-mindedness; it is also inherent in the text and in the understanding of the concept of *having dominion*, that man, in his stewardship of nature, must be accountable to God for his actions. Mankind may not treat nature indiscriminately, therefore. For example, the Jews were not allowed to deplete the soil, but had to cultivate a piece of land in such a way as to grant it "a year of solemn rest" every seventh year (Leviticus 25:5). In that way, nature is described as a work of creation designed by God so that, properly managed, it should satisfy mankind's needs as best possible. On the basis of that description, it can be regarded as a misunderstanding and a violation of God to start transforming nature. As Ole Jensen states, it is also contestable perhaps that nature, by virtue of its creation, encompasses a glory and a splendour that must not be ignored:

"Man is allowed to make use of the earth's amenities without having to fear forces in the soil, provided that he respects the earth as something that is not just available as his allotment, but has dignity in its own right".[106]

104 Passmore, 1995, Attitudes to Nature.
105 Ibid, p. 131.
106 Jensen, 2001, *At hente rummet ind igen,* Council's translation.

During the 1600s and 1700s there arose a real dominion-oriented perception of nature, fuelled partly by a variety of philosophical theories about man and nature. This natural philosophy can scarcely be said to have lost its foothold in the western world, but more recent times have seen attempts to formulate a "Christian environmental ethic", constituting a counterpart to the dominion-oriented view.[107] Some exegeses thus gain their momentum from the way in which God, according to the Bible, views nature. Amongst other passages, Genesis 1:31 shows that God assesses the individual species and the Creation in its entirety: "And God saw everything that He had made, and behold, it was very good."

This has been construed by J.B. Callicott such that all species individually have intrinsic value, i.e. they have a value per se, independent of their importance to mankind.[108]

The normative consequences of this interpretation, according to Callicott, are that we humans are a sort of stewards of nature and have a responsibility to protect the species, although we can certainly derive benefit from the individual animals and plants if done in an acceptable and sustainable fashion:

"Hence people may freely use individual living beings as natural resources – sentient and nonsentient alike – without the least moral compunction, as long as the earth's complement of species and inorganic natural appointments are not destroyed or degraded. Central to the stewardship idea is that each human generation holds God's creation in sacred trust, lives on the surplus, and passes on to the next generation a renewed edition, complete and intact."[109]

107 See Haaning, 2001, "… Der lød med ét en sælsom lyd", for a description of how the dominion-oriented view of nature has never been absolute in Christianity, historically speaking. Conversely, according to Haaning, it has been dominant for long periods because God has been viewed as being entirely separate from the creation.

108 Callicott, 1994, Earth's Insights.

109 Ibid. By way of illustration it can be mentioned that the Lutheran World Federation – Department for World Service has published a "Position Paper on Genetically Modified Organisms (GMOs) in Emergency and Development Operations" based precisely on the notion of stewardship, see: http://www.lutheranworld.org/What_We_Do/DWS/Focus_Areas/DWS-FA_Sustainable_Development.html).

In that part of the world where Christianity has been the mainstay of culture, the conception of nature has typically been characterized by deliberation between dominion *over* nature and conservation *of* nature. These two objectives have different implications for the discussion on GM plants. In light of the desire for natural conservation, the obvious thing is to dismiss any form of genetic modification of plants on the grounds that it constitutes a violation of the Creator's work. Conversely, based on the dominion-of-nature notion, it will basically be acceptable to perform genetic modifications, provided it benefits man and the Creator's work. Any deliberation of these conflicts based on the mindset that we are stewards of nature must lead to genetic modification being acceptable only if it can be done without spoiling or degrading the Creator's work. And the difficulty of evaluating and predicting this goes to the very heart of the actual problem.

Islam

Islamic natural philosophy hosts some of the same components as the Old Testament traditions. On the one hand the Koran shows that man has a special status in relation to the rest of nature. Man is a kind of viceroy and to some degree forms the lynchpin of the whole of Creation, one of nature's most essential purposes being to provide a resource for mankind. One interpreter of the Koran describes it thus:
"Nature exists for man to exploit for his own ends, while the end of man himself is nothing else but to serve God, to be grateful to Him, and to worship Him alone. The utility, serviceability, and exploitability of nature are spoken of in many verses".[110]

In this way, therefore, the Koran includes an anthropocentric component, which also emerges from the account of Creation in Genesis.

On the other hand Islam also has certain components that can point the way to a biocentric view of nature, in which mankind not only has to take heed of himself but also other living beings. Islam, too, regards nature as having a right to respect, not because nature per se is holy but because, having been created by Allah, nature *reflects* something

110 The passage originates from Fazlur Raman and is quoted here from Callicott, 1994, Earth's Insights.

of His divinity. For that same reason, mankind should not just treat nature as he sees fit. Man is an administrator, who should treat nature with the respect and consideration that is its due, having been created by God, just as man himself was. Based on the Koran there is no precluding that other forms of life have an existence equatable with that of man. Some interpreters, for example, will refer to the following passage as evidence of such a philosophy: "And there is no animal that walks upon the earth nor a bird that flies with its two wings but (they are) genera like yourselves" (6:38).[111]

In some people's opinion, Islam also shares certain similarities with a deep-ecological natural philosophy. For example, Nawal Ammar states that the universe can be viewed as a cohesive whole from an Islamic basis, with no one component having a greater value than any other, in principle:

"The whole universe is one single system created and united by Allah. Looking at the universe with such a perspective where all creatures are connected reveals common principles in Islam and deep ecology. Humans and other creations here have a relationship with each other and the universe reflecting kinship, admiration, respect, contemplation, adoration and consideration, but not sacredness".[112]

Hinduism

Looking at Hinduism, the problem of providing an authoritative interpretation that establishes the correct view would seem to be even greater. For example, J. Baird Callicott asserts that:

"In sharp contrast to Islam – which is of relatively recent origin, as global religions go – the origins of Hinduism reach into that dim twilight zone between prehistory and history. Also in sharp contrast to Islam – which is self-contained and doctrinally well defined – Hinduism is so varied, both classically and in its eventual modern forms, that it resists facile doctrinal definition".[113]

111 Translation taken from an online version of The Holy Qur'an, translated by M.H. Shakir and published by Tahrike Tarsile Qur'an, Inc., 1983.

112 Ammar, 2001, Islam and Deep Ecology.

113 Callicott, 1994, Earth's Insights, p. 44.

Callicott points out that Hinduism's view of nature is just as ambivalent as that of the western world's religions, for Hinduism includes components that can justify a devaluing view of nature as well as components advocating a respectful approach to nature.

The devaluing attitude to nature is founded primarily in the fact that, according to Hinduism, the physical world can be viewed as an imaginary world, which may certainly be interesting and exciting, but can simultaneously lead mankind astray. According to certain branches of Hinduism, the actual goal of religious endeavour is to become one with *Brahman*, the undifferentiated essence of reality and basis of all things, which can only happen after a series of reincarnations. But this requires one not to give oneself over to a sensual life, because according to the *Law of Karma*, such a life leads to reincarnation at a lower level than a more world-renouncing life would have done. To summarize, then, it can be said that:

"Looked at from the Hindu perspective, therefore, the empirical world is both unimportant, because it is not ultimately real, and contemptible, because it seduces the soul into crediting appearances, pursuing false ends, and thus earning bad *Karma*. It distracts the soul from seeking its own true nature and thereby attaining liberation from the empirical world and merging with the essential, transcendental, undifferentiated Being/Consciousness".[114]

The "world-renouncing" view of nature described contrasts with the fact that a number of writings, texts, and religious and meditative practices support a respectful view of nature. Mankind and nature are often regarded as equal-ranking elements in an holistic formation where it makes no sense to attribute separate meaning and significance to the individual, undifferentiated parts. This is emphasized by the fact that the individual may perfectly well have been a creature of a different species in a former incarnation, which in its own right provides a basis for human solidarity with nature. And the very experience of mankind meshing and engaging with nature can be a goal of meditative practice, because it can pave the way for a knowledge of the underlying being, *Brahman*. According to some

114 Ibid, p. 48.

interpreters, therefore, Hinduism can certainly be used to justify a biocentric or deep-organic natural philosophy. For example, C.K. Chapple states that:

"In a Hindu context, deep ecology can be affirmed through reflection on traditional texts that proclaim a continuity between the human order and nature, through ritual activities, and through applying meditative techniques that foster a felt experience of one's relationship with the element".[115]

Chapple is aware that ritual activities, like yoga for example, can be thought of as activities of a primarily introspective nature, therefore having no ethical implications in terms of nature. But Chapple states that the path to spiritual liberation (*moksa*) calls for reciprocality and exchange between the material and the spiritual, exemplifying how, in practice, the Hindu tradition has translated this recognition into environment-conserving activities. Just how prominent the world-renouncing components of Hinduism are in practice is open to discussion, therefore, but since Hinduism admits of so many different branches and forms of practice, it is difficult to express a view on a general level.

At all events, it is debatable whether the Hindu tradition encompasses resources that can be used as grounds for an environmental ethics with an organic face, where entities like species and ecosystems per se are also the subject of ethical deliberations. Some people feel that this is not the case because, in the final analysis, the Hindu conception of nature merely expresses an 'unaddressed' (mystical or romantic) philosophy of "respecting the living" or "respecting nature".[116] The specific object of that respect thus becomes quite random; for instance, it may just as well be a spot in the woods that is considered holy as an animal that achieves the status of being "a little god" etc. If this is correct, then by dint of its philosophy of nature, Hinduism cannot provide a basis for taking a position on more concrete environmental issues, for example regarding the ethical justification for GM plants.

115 Chapple, 2001, Hinduism and Deep Ecology, p. 74.
116 See e.g. Callicott, Earth's Insights, pp. 49-53.

Buddhism

Since Buddhism developed from Hinduism, it is scarcely that strange that the two religions embrace some of the same resources as regards the development of an environmental ethics. This is seen most clearly perhaps in the descriptions of meditation, where it is also central to Buddhism that meditation can lead to a kind of identification with nature as a whole, which can lead to an appreciation of and solidarity with other beings and, in a more extended sense, the Creation as a whole. It can be claimed, however, that this component is assigned greater weight in the Buddhist than in the Hindu ideology, for the simple reason that Buddhism does not regard the physical world as an imaginary world.

The intention of meditation is not, as it is for Hindus, to recognize the 'real' world behind the physical appearance, for no more valuable form of being exists behind that which is immediately recognizable. In that sense, then, Buddhism does not embrace a devaluing view of nature as such. One aspect of Buddhism, however, is that life is suffering, and that it is craving and thirsting for life that religious practice will help to overcome. This is made clear, for instance, by Buddha's Barents speech, which states inter alia:

"Moreover, monks, for the noble it is a fact that suffering has its end, to wit total cessation, i.e. dispassionateness, renunciation, rejection, liberation and independence from that self-same urge".[117]

This may speak in favour of a more passive and non-committal attitude to nature, perhaps, but as with Hinduism it is a moot point how salient this component is in practice.

One of the key figures of Buddhism at present, the Dalai Lama, is an example of not necessarily being uninterested in environmental issues as a Buddhist. The Dalai Lama thus speaks in favour of sustainable development, attempting to preserve individual species. In *Universal Responsibility and the Environment*, for example, it is stated that:

117 Vinaya Pitaka I,10, translated from the Danish version quoted by Alster & Lindter, 1996, in Gads religions historiske tekster, p. 142.

“Exploration of outer space takes place at the same time the earth’s own oceans, seas, and freshwater areas grow increasingly polluted, and their life-forms are still largely unknown or misunderstood. Many of the earth’s habitats, animals, plants insects, and even microorganisms that we know as rare may not be known at all to future generations. We have the capability and the responsibility. We must act before it is too late”.”[118]

From none of the four religions discussed here does it appear possible to infer a specific view on GM plants. This is partly to do with each of the four religions having a composite and, in part, contradictory conception of nature. Another reason, of course, is that the religions’ basic texts and views came into existence several centuries ago and can therefore seldom be used to relate directly to the genetic engineering problems of our time. What scope the individual religions hold for positing arguments for and against the new technologies, respectively, therefore remains to be clarified.[119]

118 See: http://www.tibet.com/Eco/dleco2.html.

119 Chapman, 2001, Religious Perspectives on Biotechnology, in: Hanson, 2001, Claiming Power over Life, which also contains several chapters on the correlation between religion and bioethics.


[soya]

Decision theory

As will be apparent from the preceding sections, it is no easy matter answering the many ethical issues that crop up in tackling the issue of releasing genetically modified plants. The hope might therefore be that the questions get easier to answer by drawing on some of the decision theories normally recruited in the service of the environment, particularly the precautionary principle and the cost-benefit analysis. These theories will be briefly set out below, but as will be shown, they do not offer any actual vision of possible answers to the ethical issues.

The precautionary principle

In line with the precautionary principle, reticence should generally be displayed in applying a technology if there is great uncertainty and ignorance surrounding the consequences of its potential use. As described above, this applies in the context of using GM plants and is also the case with a great many other technologies. In this case, one speaks of decision-making under uncertainty, and in international context it is recommended using the precautionary principle as the basis for making political decisions, particularly when those decisions concern the environmental field. The idea is partly that a lack of scientific knowledge should not be able to be used as justification for deferring measures capable of averting the destruction of the environment (compare the Rio Declaration). In that sense the precautionary principle presupposes that the use of new technologies must be sustainable.

The precautionary principle can be interpreted in several ways, but the point of departure adopted in the following is the European Commission's construction from 2000: *Communication from the*

Commission on the precautionary principle.[120] According to this interpretation, adoption of the precautionary principle follows three phases.

The first phase maps whether there is a risk that using a particular technology can have negative consequences. According to the Commission this must be a *scientific* survey, where precise "identification of the potentially negative effects of a phenomenon" takes place.[121] It is not sufficient, in other words, to refer to a vague concern that 'something' may go wrong because the processes in question are inscrutable and complicated, or suchlike. *What* can go wrong must be specified, just as some scientific reasoning must be given *why* this might conceivably be the case. Consideration can be given to applying the precautionary principle if possible adverse knock-on effects can be flagged, and the risk "cannot be fully demonstrated or quantified or its effects determined because of the insufficiency or inclusive nature of the scientific data."[122] The precautionary principle, then, addresses decision-making under uncertainty, but that uncertainty does not relate primarily to the nature of the knock-on effects but rather to the risk of them occurring.

During the second phase a political decision will have to be made as to whether the scientific survey actually warrants applying the precautionary principle. The European Commission's directions concerning when this is the case are not especially comprehensive, referring primarily to the "appropriate response in a given situation" as being "the result of an eminently political decision, a function of the risk level that is 'acceptable' to the society on which the risk is imposed".[123] However, this says nothing about how to determine an acceptable risk. By the same token, the Commission does not take a stand on the inherent contradiction in the need to determine what is an acceptable risk level when the size of the risk is not known.

120 European Commission, 2000, Communication from the Commission – on the precautionary principle.
121 Ibid, p. 14.
122 Ibid, pp. 13-14.
123 Ibid, p. 16.

If a political decision is made to apply the precautionary principle, it must be decided in *the third phase* which preventive measures it is wished to introduce in order "to eliminate the risk or at least reduce it to the minimum acceptable level".[124] Such measures may range from informing the public to issuing an actual ban, but the Commission emphasizes that measures must not be random. They must conform to a number of guidelines set down by the Commission, inter alia that they must be proportional to the chosen level of protection, consistent with similar measures already taken, based on an examination of the potential benefits and costs of action or lack of action and so on. In addition, such measures must be regarded as provisional, since it must be attempted to provide more comprehensive scientific knowledge about the risk, which can serve as a basis for a fresh decision regarding such precautionary measures.

The European Commission's interpretation of the precautionary principle is open to criticism on many levels. Among other things, it can be adduced that it is simply not far-reaching enough, because in many contexts it will be difficult to single out the specific knock-on effects of using a particular technology. In this context, however, it is paramount to point out that the Commission's interpretation should presumably be perceived above all as an attempt to describe how the political decision-making process should operate in connection with decision-making under uncertainty, which is why it contains no evolved vision of how to factor utility, ethics and belief into an evaluation of GM plants. However, the interpretation does include some clear approaches to the ethical debate: for example, the need to also take account of future generations' opportunities, particularly where knock-on effects on the workings of ecosystems are concerned:

"the potential long-term effects must be taken into account in evaluating the proportionality of measures in the form of rapid action to limit or eliminate a risk whose effects will not surface until ten or twenty years later or will affect future generations".[125]

124 Ibid, p. 8.
125 Ibid, p. 19..

But to a great many of the other questions concerning ethical or other values associated with invoking the precautionary principle in practice, the Commission's interpretation provides no clear answer. This applies, for instance, to the question of what to even include as an adverse knock-on effect, on which some position needs to be taken during the first phase. Is it merely adverse effects on human health and the environment, or should, say, knock-on effects for agricultural production methods also be included? At the request of the Danes, this has been debated heavily, but the Commission's interpretation contains no answer to the question, just as it provides no answer to whether nature per se ought to be protected, or whether or not bred varieties of grain count as part of nature.[126] Overall, then, the interpretation relates only minimally to the ethical parameters crucial to whether something can be described as an adverse knock-on effect.

Similar problems arise in both phases two and three. In phase two, as mentioned, the interpretation offers no vision of how to determine the acceptable risk level; and phase three contains reference to the fact that the decision to introduce measures to limit the risk must include cost-benefit analyses (see below). This formulation opens the way for the inclusion of considerations of utility as part of the overall decision, but it is not stated either whether the cost-benefit analysis should have a crucial bearing on the decision, or what counts as useful consequences. In that sense, therefore, the interpretation does not address the altogether central issues associated with applying considerations of utility.

It can only be concluded that the European Commission's interpretation of the precautionary principle fails to clarify how, in more precise terms, utility, ethics and belief should be incorporated in the assessment of GM plants. On the contrary, the interpretation *presupposes* that the relevant states are able to reach a stance on these issues themselves.

126 Carr, 2000, Ethical and value-based aspects of the Precautionary Principle.

Cost-benefit analyses

As mentioned above, the European Commission refers to the need to include cost-benefit analyses as part of the precautionary principle. Given that it is common practice to use these types of analysis for technology evaluation purposes, they must be mentioned here, in gist at least. Put in simplified terms, the analysis comprises two steps.[127] The first step maps the consequences of implementing a particular initiative, which—cf. the presentation of the precautionary principle, for instance—might be to institute special precautionary measures. Then the total *value* of this must be calculated; in principle this is done by identifying the willingness of the players involved to pay for the consequences which that initiative has. If the price of instituting the initiative is less than the players' propensity to pay in relation to the anticipated consequences of the initiative, implementing it will be deemed justified. The analysis concerned thus rests on a utilitarian foundation, which is to say that the correct action or correct initiative is whatever maximizes the total set of utility or quality of life.

The value of the initiative's consequences is calculated with the aid of several different methods. In some instances future consumers can be asked straight out what they are willing to pay for the marketable goods which are a consequence of the initiative. It might be, say, whatever people are willing to pay (over the odds) for a particular GM food to have been thoroughly tested in terms of its risk to human health. In other instances, however, more indirect methods need to be used to establish that value. This applies particularly in relation to the initiative's impact on the environment, given that it involves a commodity that can only seldom be marketed. Here, for example, the analysis studies how great a difference there is in house prices when houses are located in a varied natural area as opposed to a non-varied area, or how much people are willing to pay for an entrance ticket to an area of scenic beauty and so on. This type of valuation entails great methodological problems, however. Amongst other things, determining the value of future goods is a problem. In economic theory, the value of *future* goods is normally discounted, as is the price of future damage, whereby the value will depend on the discount rate

127 The following account is based on the Danish Environmental Assessment Institute, 2004, *Miljøøkonomiske analysemetoder med fokus på costbenefitanalysen.*

selected. Yet this is often determined rather haphazardly.[128] This makes compiling cost-benefit analyses for technologies like genetic modification of plants, where the application can have long-term consequences, problematic.

Perhaps cost-benefit analyses may provide a pointer to whether implementing an initiative to limit the risk associated with a particular technology is entirely misguided, but it is essential to be aware that cost-benefit analyses, like the precautionary principle, are no substitute for ethical analysis. This is because analyses are blind to a number of essential ethical issues such as the distribution of benefits and harms, regard for sustainability and the way in which uncertainty about the effects of using a particular technology has to be handled. There is no straightforward way of incorporating these types of consideration into the valuations of the analysis.

128 See e.g. Møller, 2002, *Costbenefitanalyse på miljø- og naturområdet.*

[cotton]

Models for the correlation between genetically modified plants, utility, ethics and belief

Outlined below are three models for the correlation between utility, ethics and belief, as well as researching and application of GM plants, i.e. the liberal model, the utility-based model and the communitarian model. Following a presentation of the models, the Council will set out its deliberations on which model should be used in different contexts.

The liberal model

According to the liberal view, evaluations of new technologies should not include utilitarian considerations directly. Instead, utilitarian considerations should be left to the potential users of the new technologies so that the application of such technologies becomes a result of each individual's free choice. As a general rule, technologies of every kind can be freely marketed—assuming, that is, that there is not an overly great risk of them harming the consumers or others. The government's task in connection with genetic engineering, then, according to this view, is, to put it crudely, to ensure that technologies and products are only released once appropriate risk evaluations have shown that they are not dangerous in relation to the parameters studied.

Furthermore, it is the government's job to ensure that an adequate amount of information about the product exists to enable consumers to select or reject it on an informed basis. In conjunction with GM plants, one of the implications of this is that any product whatsoever must show whether it contains GMOs or whether GMOs have been used during the making of it. Such product labelling makes it possible for consumers critical of GM foods to "opt out" of those products, whether the consumers' scepticism is due to fear of ingesting the products, rooted in resistance to releasing GM plants into the wild or due to more fundamental resistance to altering living organisms with the aid of genetic engineering. As mentioned earlier in this report, consumers' opposition to GM plants is due not primarily to a fear that ingesting them may involve some risk. Such opposition is due to other factors. For example, some people consider that GM plants are unnatural, while others think that trading in them benefits primarily the large multinational growers and manufacturers.

The main rationale behind the liberal model is that there is great internal disagreement in western societies as to what characterizes a good life and hence also disagreement as to what is useful. Firstly, people choose quite different things in their lives, and in practice, as is known, there are great disagreements as to whether a new technology, say, actually serves to make our lives better or, rather, poorer; and secondly, on a more theoretical plane, among philosophers, theologians and others, for instance, who have attempted to clarify the question, there is no theoretical agreement as to what characterizes a good life. There is not even agreement that there is a genuine theoretical question in need of clarification.

This disagreement concerning the good life can be viewed as part of the background to one of the ideas central to liberal societies, that the state or the community must not force particular perceptions of the good life on its citizens. The state must protect individuals' fundamental (civil and political) rights and according to some variants also safeguard certain minimal opportunities for everyone, but it is up to people themselves to determine their view of the good life and to arrange their lives in accordance with their convictions. Or, as they say, the state must not promote particular perceptions of the good, but make room for all (reasonable) views of the good.

European regulation of GMOs can quite be perceived as regulation along the lines of the liberal model. Primarily, then, the intention of European Parliament and Council Directive 2001/18/EC is to protect people's health and the environment in accordance with the precautionary principle. This can be interpreted in such a way that the assessment of products is left to the consumers, albeit subject to the proviso that the products may not actually harm human interests. In the final analysis, therefore, it is a scientific risk evaluation that forms the basis for whether or not a GM plant may be used. It is essential, however, to realize that an unadulteratedly liberal model for the approval of GM plants may be flawed in several respects.

Thus the liberal model can find it hard to cope with the concept of risk. The idea of the liberal model, quite generally, is that an individual must have the freedom to live by his or her own values and ideals as long as his or her self-actualization does not harm others in any obvious or direct sense. But of course, there will not be much free self-actualization left if the individual's freedom can be ring-fenced as soon as there is the slightest *risk* of his or her self-actualization harming others. The problem with the liberal model in that respect is that it may have difficulty offering a theoretically well-founded proposition of when a risk is sufficiently great as to warrant intervening and, in that case, with what means. For the point of the liberal model, as mentioned, is partly that the state must remain neutral in matters concerning values. For this very reason the liberal model can scarcely seek refuge in cost-benefit considerations or other considerations based on utility, as these types of consideration require an ability to "gauge" the negative and positive effects linked with, respectively, the risk and the individual's self-actualization. Yet it is precisely such a valuation that the liberal model endeavours to avoid. In practice, however, the problem is not barely so great, as the liberal model is not inconsistent with a person who has caused harm or damage to others through risky behaviour being ordered to give the injured person a reasonable degree of compensation. Usually, moreover, there will be a degree of consensus in a society about the value and importance ascribed to carrying out particular activities or being exposed to particular risks. This consensus can be used to determine which risks are acceptable.

The problems with handling risk which the liberal model can be said to have at a theoretical level may possibly have found their way into the interpretation of the precautionary principle proffered by the European Commission. Thus the Commission's directions include no response as to when a risk is actually too great to be acceptable. This is deemed to be a national policy decision, primarily, just as evaluating what means are appropriate for use in staving off the risk is largely deemed to be a political decision. Of course, these must be proportional to the level of risk it has been decided to consider acceptable. But as to the actual starting point for invoking the precautionary principle—i.e. the choice of acceptable risk level—the directions are tellingly silent.

The problem of risk is associated, as mentioned, with another one: that in practice it is difficult for the liberal model not to take a stance on some of the basic issues concerning ethical and other values which in principle it is intended to let individuals decide. For example, the obligations we have in relation to future generations, and the degree of protection nature should enjoy. The problem is that one cannot expect considerations like these to be covered if they are not built into the legislation, because this type of benefit is difficult to create or preserve by virtue of individuals' free choice. This applies, inter alia, to *collective benefits*, i.e. benefits that cannot be distributed to single individuals and are not necessarily diminished by being used. It might be, for example, magnificent and varied countryside, accessible to generations present and future. Maintaining such natural amenities requires extensive coordination of a number of diverse factors, coordination that cannot be guaranteed to be implemented if left to the choice of individuals. The same can be said of other natural and environmental benefits, such as functional ecosystems, clean groundwater or a clean environment.

The liberal view is consistent with ordering the manufacturer, and hence ultimately the end-consumer wherever possible, to cover the costs of a more social nature associated with the manufacture of a specific product. These might be, say, expenses connected with pollution or ensuring that a GM plant does not spread to the surrounding environment. Similarly, the view is consistent with the inclusion of utility assessments to some extent in connection with the allocation of government research funds.

The utility-based view

As mentioned previously, according to some views ethical considerations can be reduced to evaluating the utility associated with carrying out a particular action or given course of action. This is the starting point, for example, of the utilitarian theory that forms a counterpart to the liberal model, at least on a theoretical level.

Because whereas the gist of the liberal model is to provide citizens with as much freedom as possible, the point of utilitarianism is to create the most utility possible, in the sense of welfare or quality of life.

The difference between the two theories is not necessarily that great in practice, however, since against the backdrop of utilitarianism and other similar theories, the role played by the state is not taken as read, either in general or in connection with the regulation of GM plants. A classic view among utilitarians has been that the state is primarily supposed to prevent some citizens from harming others. Furthermore, wherever possible, the state should leave decisions to citizens themselves, as they are best at gauging and fostering their own interests.[129] This view directly underpins the liberal view concerning the regulation of GM crops.

An alternative view, however, might quite well be that the state should use a modified version of the liberal view as a basis for evaluating GMOs. Such a modified version contains two components.

1. The state should *approve* the use of a specific GM plant in cases where the risk of using the organism is deemed minimal or the authorities' overall evaluation is that the use of this organism may be expected to have beneficial consequences in toto. It is not a necessary condition, therefore, that use of the organism involves no risk or merely involves minimal risk; but if there is a risk, the anticipated *benefits* of using the organism must exceed the drawbacks, in social terms.

2. Approval of a particular GM plant should not be tantamount to *rubber stamping* its use. On the contrary, the risks associated with using it should be clearly stated in the marketing, as well as the fact that it is a GMO. On that basis the individual consumer can opt not to use the organism, if so desired, either for ethical reasons or because the risk is considered high by him or her as compared with the benefits.

On the face of it the utility-based view may be thought to be more logical than the liberal view. It is perfectly normal practice for the

129 See John Stuart Mill (1987): On Liberty

individual to base what he or she does on the *overall* assessment of possible benefits and drawbacks of an action or course of action. Thus most people are willing to run a certain risk as long as the benefits are great enough. Many do so every day, for instance, in traffic, although admittedly the risk evaluations involved are based on very different considerations and values. The utility-based view, unlike the liberal view, makes such weighing-up possible.

However, it is essential to be aware that both the liberal and the utility-based view restrict the individual's options, albeit different forms of restriction are involved. The liberal model does not leave it to the actual individual to weigh up the benefits and risks, as the use of GM plants is only permitted if they have minimal risk associated with them, both for society and for the actual individual. Conversely, the utility-based view permits the individual to perform such weighing-up, but only on the condition that using the plant is deemed to have beneficial consequences for society as a whole.

Adherents of the utility-based view will presumably criticize the liberal view for not permitting utility and risk to be weighed up. Conversely, adherents of the liberal view will presumably criticize the utility-based view both for leaving the overall utility assessment to the public authorities and for allowing the individual to run a risk in principle by using a product without that risk being offset by equivalent benefits for him or herself.

One consequence of the utility-based view is that advocating the use of a GMO may be well-founded in some countries but not in others, because the overall beneficial effect of using it will differ from one country to another. For example, it might be well-founded to use a plant of great nutritional value in a developing country with general malnutrition, although a non-negligible risk would be attached to ingesting it, because that risk would be offset by the improved state of nutrition. By contrast, that would not be the case in countries without nutritional problems, where the risk would be a crucial argument for preventing use of the plant. It may be thought that this asymmetry in terms of approving GM crops militates against the utility-based view. Alternatively, it may be asserted that the utility-based view reaches pragmatically correct conclusions in a situation that is far from being ideal, owing to the striking differences in affluence between countries. In general it may perhaps be said that utility-based theories excel at being both attuned to reality and geared towards viewing things as a whole. On the other hand the theories have no sense of the fact that some values are perhaps neither consistent with nor can be reduced to utilitarian considerations. For example, it is a not uncommon view that nature and the countryside have a value independent of the joy we derive from being in it and beholding it (compare the section on ecocentrism).

The communitarian view

According to the communitarian view the state should evaluate the researching and application of new technologies on the basis of the fundamental values and views that are entrenched in the particular culture and are instrumental in establishing social cohesion and affinity. Such values and views will typically be part of the historical tradition, mirroring themselves in and constituting the reasoning for a large number of the central practices developed in that particular society.

The communitarian view scarcely offers quite such a simple vision of how to include considerations of utility in GMO assessment as the liberal or utility-based view. This is partly to do with the fact that specific values and views cannot be unequivocally designated the fundamental values in a particular culture. But it is also partly to do with the fact that any realistic communitarianism has to acknowledge that a particular culture plays host to a multiplicity of relatively fundamental values that do not necessarily have the same implications in a particular situation. In practice, therefore, state regulation of GMO research and application must always take the form of weighing up the values held to be central. In a Danish context, then, it would be possible to point to a number of different values that would necessarily have to be included in such weighing-up. One value would be the preservation and conservation of unspoiled natural amenities; another, to satisfy fundamental human needs; a third, to hold individuals accountable for their own free choices; a fourth, to accept and support people's ability and urge to live and choose according to their own values etc.

It is difficult to voice any opinion about the outcome of such weighing-up, but a conservative guesstimate is that it would depend greatly on the specific application of the GM plants in question. For example, the state might primarily be envisaged as being able to sanction two forms of application, i.e. one aimed at satisfying fundamental human needs and one aimed at restoring or preventing some destruction of the environment. In other contexts communitarianism would possibly dictate against the use of GMOs from the point of view that the values that could be supported by this application are not sufficiently strong to outcompete the respect for the integrity of nature built into our tradition and culture. As has been shown, therefore, it is not certain that considerations of utility would be included in the communitarian philosophy in any immediate sense, though in an indirect sense, of course, it would be a matter of evaluating which measures were most useful in terms of promoting the values that make up a fundamental constituent of our culture. From a communitarian view, incidentally, it is perfectly fair to stipulate both a minimal risk and a documented utility requirement—both judged on the basis of society's basic values.

In passing, it should be noted that the communitarian view can be justified, inter alia, by the simple inability of the powers that be to legislate without basing their work on values. If this is the case, however, it seems most valid to legislate on the basis of those values that can be considered a mainstay of the culture, at least if those values cannot be written off as misplaced or out-and-out erroneous from the very outset. Moreover, it should be the task of government to ensure a certain cohesion in society, which can be done precisely by bolstering the values that are entrenched in the culture and thus constitute a common feature or common ground.

The Council of Ethics' recommendations and comments

In a Danish context it is neither desirable nor realistic, perhaps, to use any one of the three models described above in its pure form. Danish tradition and culture are too complex for that, no doubt, seemingly incorporating elements of both the liberal, the utility-based and the communitarian tradition. The challenge, therefore, is chiefly to highlight how elements from the three models can be combined to achieve an ideal vision of the way approval procedures and research grants in the field are supposed to function. It is just such a vision that the members of the Council will attempt to provide below.

Equally important is the question of how to go about dealing with the relatively widespread aversion that exists among the Danish population in relation to GM plants and foods.[130] Should this scepticism be countered by means of public information campaigns, so that foods based on GM plants may possibly cease along the way to have the distinctive status they have at the moment? Should it be accommodated so as to ban all release of GM plants? Should we wait and see where developments take us until we have more credible, consensual feedback on the actual consequences that developing and applying GM plants will have? Or is it a field in which the debate should be continued, in the hope of achieving some consensus? The Council thinks there is a need to have a public debate on this type of question in Denmark.

The Council considers that the question of *research* into GM plants should be viewed independently of any application and release of GM

130 A survey from 2006 of the Danes' knowledge of and attitude towards GMO thus showed that 51% of Danes would or would probably opt out of GMO labelled foods if they found them in supermarkets (see Danish Consumer Council's homepage: www.fbr.dk).

plants. Independent and critical research into GM plants at the highest international level is key to responsible position-taking on the possible application and use of GM plants. This refers not only to narrow research into development and risk evaluation of GM plants but also wider perspectives that take on board social, ethical and global aspects.

Application and release of genetically modified plants and sustainability

During the work on this report, the Danish Council of Ethics has ascertained that sustainability is an overarching consideration that occupies a prominent position in the legislation and treaties, also where GM plants are concerned. In the following, therefore, the Council will comment on a number of aspects connected with GM plants and sustainability.

In the Council's opinion sustainability is defined and interpreted in a number of different ways and from different perspectives by different players. From a general perspective, however, the concept is often used as an umbrella term for a series of divergent and individually demanding concerns such as consideration for the needs of posterity; concern about a reasonable distribution of resources and options for action, both locally and globally, so as to provide and cater for disadvantaged groups; concern for conserving nature and natural diversity etc. Broadly construed, therefore, the concept of sustainability in this context says that the release of GM plants should be evaluated from a holistic angle and perspective, also taking into consideration the interests of the most disadvantaged and of posterity. In that sense the concept of sustainability subsumes an interpretation of *who or what* the use of GM plants should take account of: Nature and posterity must also be taken into consideration, and the needs of the most disadvantaged must be attributed special emphasis.

Since the concept of sustainability is thus an "umbrella term" for a number of different considerations, it is not immediately prescriptive. Before it can be applied in practice, the various considerations covered by the concept have to be weighed up. The question of how to act if it is wished to safeguard "sustainable development" is therefore an open-ended one; it depends on which considerations covered by the concept of sustainability as a generic term it is wished to assign highest priority. Against this background the Council feels that in applying the sustainability concept to the debate on the release of GM plants there is a risk that the debate will become clouded, in as much as the anticipated consensus on the need for development to be sustainable – something everyone can agree on – can veil genuine and crucial disagreement about the considerations that ought ultimately to be emphasized.

Despite the many different potential interpretations of the sustainability concept, however, the Council thinks that the concept is, and has been, of essential and particularly positive importance in debating and regulating GM plants. From this point of view the use of the concept has contributed to ensuring that essential ethical considerations have been given a prominent place in the debate. These considerations have thereby come to constitute what is now taken for granted as the basis for adopting a stance on the release of GM plants.

In order to lend visibility to the values on which a particular evaluation is based, some members of the Council therefore think that if a decision concerning a possible release is to be subjected to a sustainability assessment, it should be made by some authority whose make-up is not confined purely to politicians and civil servants. Based on a Norwegian model, such a body might possibly have a more comprehensive mandate to advise and generate debate around the problem issues involved in approving GM plants.

All members stress the risk that the release of GM species may, owing to the risk of spread, potentially lead to a reduction in biodiversity and ecosystems' ability to function optimally. This risk, combined with the possible irreversibility of such changes, should result in people adopting a restrictive construction of the precautionary principle out of deference for the concept of sustainability and therefore displaying all-round reticence as regards the release of GM plants.

At the same time, the Council takes the view that the controlled release of GM plants should not be excluded a priori. In principle, it can be just as problematic to use plants that have been developed with the aid of traditional breeding methods such as mutation breeding. Here, too, existing species are altered, and these plants can also have inadvertent negative consequences – and, as in the context of genetic modification, those consequences can be irreversible. The Council considers that there is no ruling out a priori that the use of GM plants can contribute to more sustainable and efficient agricultural practice and greater natural abundance.

Utility and release of genetically modified plants

The Danish Council of Ethics has discussed how utility assessments should be included in the evaluation of GM plants destined for release. The Council has found this discussion tricky, partly because there is no agreement about objective standards governing when something is useful or not. Behind any concept of utility there invariably lies a more or less personal set of values that also needs airing. In addition, there is often uncertainty surrounding the effects of using a particular GM plant in practice. This is due not merely to the difficulty of predicting the direct and indirect risks and the useful effects brought about by the actual GM plant and its cultivation, theoretically, but also to the consequences of the actual application depending on a number of other social and human factors that are difficult to assimilate. For example, it is not obvious that the option of buying GM low-fat crisps and chips will actually result in fewer people becoming overweight or whether people will simply eat more crisps– given that they are now low in fat – or top up with an ice-cream. And in the same way, it is not a given that GM cassava plants with reduced cyanide content will actually improve the state of health in third-world countries. It is conceivable that farmers might not be able to get hold of the seeds, or that logistics and the level of information will make it impossible to separate the GM plants from the non-GM ones.

What is more, the consideration of utility is merely one of several considerations that need to be included in an overall evaluation, and weighing up the different considerations is often difficult to do, for both theoretical and practical reasons. Finally, utility assessments can be played out on a number of different levels. They can be part of the individual's adopted position on whether he or she wishes to make use of a particular GM plant. They can be part of a social clarification of how to relate to a particular GM plant or to GMOs in general. They can be part of research subsidization decisions or they can be part of a political debate on how to regulate the area. Depending on the type of discussion involved, the discussion about utility is played out on completely different terms.

The above demonstrates the difficulty of coming up with simple recommendations for incorporating utility in the evaluation of GM plants intended for release. The Council *does* wish to produce one joint overall consideration, however, and to outline two main points of view represented on the Council in addition. While the joint consideration concerns the evaluation of GM plants in a broader sense, the two main points of view are closely connected with the role that should be played by considerations of utility in connection with the authorities' approval procedure for releasing GM plants. Finally, some members wish to add some views on the possible significance of GM plants for the formation of monopolies and hence possibly also for arable farming.

Evaluation of genetically modified plants should be done holistically
The members of the Council agree that, ideally, evaluation of whether a particular GM plant may be released should be done on the basis of an holistic assessment. Among other things that assessment must take into account that using the plant can have irreversible consequences and that the concept of sustainable development must be part of the underlying value set for any position-taking. By the same token, the *actual* consequences which that use can be presumed to have must be evaluated, and this must be compared with the benefits and drawbacks associated with the other realistic possibilities, which can also have irreversible consequences.

The members are aware that this viewpoint is too imprecise to be prescriptive prima facie, but they find that technology assessments both in connection with GM plants and in other fields should not take place on the basis of too narrow a logic, partially ignoring some of the specific contexts in which the technology is to be used. With this recommendation the Council wishes to urge the avoidance of such technological narrowmindedness as far as possible. It is proposed that ethical concerns and principles be ascribed major importance in the holistic evaluation.

In the following the Council sets out its recommendations regarding the role that utility or considerations of utility should play in the governmental approval procedure for releasing GM plants.

1st main point of view regarding utility and release of genetically modified plants

The members of this group (Peder Agger, Jon Andersen, Elisabeth Dons Christensen, Karen Gausland, Ole Hartling, Thomas G. Jensen, Morten Kvist, Anette R. Nissen, Kit Louise Strand and Peter Øhrstrøm) think that considerations of utility should have a place in the governmental approval procedure. The members disagree, however, on the more precise role considerations of utility are to have.

Some members (Peder Agger, Elisabeth Dons Christensen, Ole Hartling and Peter Øhrstrøm) think that GM plants can only be approved for release if it can be demonstrated with great probability that only minimal risk is associated with their use, besides which it must have been shown with reasonable probability that their release may entail substantial benefit, or essential utility. By “essential utility” the members are referring to the fact that GM plants must either be able to satisfy fundamental human needs or remedy essential environmental problems, where this is not possible in any other way. GM plants not associated with essential utility cannot be approved, irrespective of whether they are otherwise considered to involve altogether minimal risks.

These members base their view on the fact that the release of GM plants can be problematic and can therefore be justified only if there is the prospect of some essential utility. In the view of these members, the integrity of nature should be respected as a basic premiss, regardless of whether or not this can be justified by reference to the interests of mankind—a view that implies, inter alia, that one should be cautious about altering existing species or creating entirely new species. For some of the members, respect for the integrity of nature has a religious rationale, mankind being regarded as stewards of a creation properly engineered by God. Other of the members refer to the organization of nature that includes a wisdom that manifests the dynamics of multiple millions of years of evolution. For that reason it can only be regarded as hubris if man flouts nature's own processes and feels justified in altering the composition of species etc. Carrying on from this, some of the members point out that there are so many uncertainties associated with the release of GM plants that it is difficult to take in—even with in-depth risk evaluations—the risks actually associated with using them in the long term. In addition, any inadvertent negative consequences will probably be irreversible, given the great likelihood of the plants spreading.

Another group of members (Jon Andersen, Karen Gausland, Thomas G. Jensen, Morten Kvist, Anette R. Nissen and Kit Louise Strand) think it is possible to weigh up utility and risk, so that GM plants can be approved, although there is no ruling out some risk, i.e. if their use as a whole is quite clearly expected to have beneficial consequences. An anticipated utility can offset a risk, in other words. These members also think that GM plants can be approved if the risk of using them is deemed to be entirely minimal, even though no anticipated utility can be linked to the plant.

These members do not consider it problematic per se to undertake genetic modifications to plants or other organisms, but the members nevertheless consider that reticence should be exercised in modifying the nature of existing plants. In the view of the members this can be risky, partly because we are not in complete command of existing techniques. It can therefore be difficult to foresee the consequences of using them. By contrast, there is some certainty that the plant occurrences and crops already used over a substantially longer span of years are not risky and can enter into the biological cycles without causing damage.

All the members under the first main point of view are conscious that, in principle, using plants developed with the aid of traditional breeding methods like mutation breeding can also be problematic. Here again the existing species are being altered, and these plants too can have inadvertent negative consequences—and as in the context of genetic modification the consequences can be irreversible. Yet the members do consider it extremely relevant to point out that genetic engineering methods are so effective that they allow highly extensive modifications to plant species and to agricultural produce within a relatively short time frame. That means, for one thing, that any inadvertent negative consequences risk becoming very far-reaching, but it also means a risk of shifting some ecological balances if, say, within a short period of time the same pesticide begins to be sprayed on extensive areas globally.

2nd main point of view regarding utility and release of genetically modified plants

Other members (Klemens Kappel, Niels Jørgen Langkilde, Anne Skare Nielsen and Anne-Marie Skov) do not think that considerations of utility should be included directly in the governmental approval procedure. If their use can be reasoned to involve a risk to people or the environment, release of the particular GM plant should be precluded. Failing that, it should be permitted prima facie to use and market it. Considerations of utility must not play any part in the approval procedure, therefore.

The members mentioned emphasize that the evaluation of any particular GM plant's utility will invariably be so elastic and subjective by nature that it should not be done by either politicians or civil servants, but by the demand on the market. As a starting point, therefore, it should be the consumers' view of utility that determines whether a particular GM plant is produced and distributed, provided that it entails no risk to humans and the environment in the view of the authorities. GM crops are thus ranked alongside other products that are marketed.

The members further think that, with extensive risk evaluations, the risks associated with GM plants can actually be contained within acceptable levels—or at any rate levels that do not differ essentially from the risks associated with, say, the use of chemicals.

3rd main point of view regarding utility and release of genetically modified plants

One member (Klavs Birkholm) feels that considerations of utility are highly relevant but become meaningless if they fail, as an altogether central feature, to take on board the dramatic structural changes in global farming accompanying the spread of patented crops. Regardless of the transition to an industrial and information society, mankind is still dependent on agriculture as his primary source of nourishment. In this member's view, it would be irresponsible, therefore, if the approving authorities were to ignore the question of the influence a particular GMO can have over the power to cultivate the soil, the development of cultivation methods and so on.

According to this main point of view any thoughts of approval must discriminate between two types of GM plant: (a) on the one hand plants that affect farming as it has traditionally been practised around the world (this applies to e.g. GM rice and GM maize for food use), and (b) on the other hand new plants whose use has no material bearing on structural conditions in farming (e.g. Aresa's land mine detector and a number of GM plants that produce raw materials for industrial purposes or medicine).

(a) In the former instance, the member thinks that the authorities should be extremely reticent about approvals. Power over the development of cultivation methods should remain, as far as possible, in the hands of the tradesmen and businessmen themselves (peasants, farmers etc.). Moving control away from the primary business, across to the boards of patent-holding companies whose main aim in life is to ensure a return for their shareholders will not only be unethical, it will also entail a potential risk for global food security. Denmark should therefore work internationally to regulate the spread of patented crops in traditional farming.

(b) In the latter instance, the member is of the opinion that, where there is some supposition that a particular GM plant can make an essential contribution to remedying a major health problem, environmental problem or suchlike, the authorities should contemplate approval, *even* though suspicions may in some cases have been voiced about some negative effect on natural biodiversity or human health. The risk and utility-value arguments for and against must be heard, but loosely founded suspicions should not be allowed to halt the progress of useful technology, the member feels.

Point of view regarding genetically modified plants and changes in agriculture

Besides the preceding points of view, some members (Peder Agger, Jon Andersen, Elisabeth Dons Christensen, Karen Gausland, Ole Hartling, Thomas G. Jensen, Morten Kvist, Anette R. Nissen, Kit Louise Strand and Peter Øhrstrøm) have expressed a wish to put forward a pronouncement of their views as follows:

As this report suggests, risk evaluations and considerations of utility almost exclusively dominate public debates on GM plants – on the one hand the risk of wreaking havoc on nature's ecosystems or man's health; on the other hand the hope that particular plants will be of potential service in the fight against, say, malnutrition. Regardless of views on how utility and risk assessments should be weighted, these members also wish to direct the spotlight onto a factor that is economic and social by nature—i.e. whether the use of GM plants is conducive to vital changes in farming culture. These members are obviously aware that many other factors are and have been decisive to developments that have taken place in the agrarian sector, but wish to point out that GM crops may ultimately play a special role, owing to their special characteristics and conditions. Once the farmer has bought a portion of GM sowing seed, according to customary practice he is not allowed to use his crop as farm-saved seed without paying a fresh fee to the patentee. This may possibly be prompted by reasons of safety, but at any rate constitutes a change in conditions. This change in farming practice gives cause for concern, and it goes without saying that knowledge about this particular aspect should be included in the debate on GM plants both nationally and internationally.

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