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COGEM REPORT
CGM/090929-01

SOCIO-ECONOMIC ASPECTS OF GMOs
BUILDING BLOCKS FOR AN EU SUSTAINABILITY ASSESSMENT OF GENETICALLY MODIFIED CROPS

INDEPENDENT SCIENTIFIC ADVICE AND INFORMATION FOR THE DUTCH GOVERNMENT

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Building blocks for an EU sustainability assessment
of genetically modified crops

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COGEM provides scientific advice to the government on the risks to human health and the environment of the production and use of GMO's and informs the government of ethical and societal issues linked to genetic modification.

FOREWORD

The request made by Minister Jacqueline Cramer to COGEM to draw up a report on the socio-economic aspects of GMOs in agriculture, with a view to advancing the protracted discussion in the EU, was a particular challenge for COGEM. Not often has the preparation of a report attracted so much attention from external parties. This shows that the debate on this topic is a delicate one and that everyone who contributes to it is being carefully watched. The suggestion of allowing socio-economic aspects to play a role in the admittance of GMOs to the EU was prompted by the desire to make the debate on this matter less cloudy and thus more quickly arrive at a decision-making stage. If not all objections have to be interpreted in terms of risks, countries which have other reasons for their objections could in this way create more space around the topic nationally so that the deadlock surrounding the admittance procedure can be broken. Socio-economic criteria however, could also lead to a series of additional requirements which permit applicants would have to meet and thus make admittance even more complicated. The difference in the possible outcome has led to increased interest in the subject.

The implementation of the request also had its unusual aspects for COGEM. COGEM was faced with the task of delineating the socio-economic aspects from the perspective of sustainability, because this was what the minister specifically requested. Although COGEM has its own expertise in the area of sustainable development, external specialists in this area were also interviewed to create as complete a picture of the issue as possible. There are various definitions of sustainability in circulation, because everyone can and should interpret this concept from their own perspective. COGEM has not defined sustainability in this report but provides a description of society's overall aim with sustainable development. COGEM also had to consider the meaning of sustainability in agriculture and discovered that there are no ready criteria for this. For some groups in society, crops which have been developed through genetic modification cannot by definition be termed sustainable. The assignment thus seemed to lead to an irreconcilable contradiction. COGEM resolved this dilemma by, right from the outset, making no judgment about whether GMOs are sustainable or not. All that has been proposed is a system which can help to establish whether or not the application of a GM crop will make a practice more or less sustainable relative to a practice where conventional agriculture is applied. Setting out a frame of reference for conventional agriculture is also complicated, however, because this is not a static concept.

This report offers building blocks which could play a part in the discussion surrounding the sustainability of GMOs in agriculture, with an emphasis on the possible use of assessment criteria to justify whether or not to admit GM crops for cultivation in the

individual member states of the EU. I hope that this COGEM report can make a contribution to reaching consensus in the EU on the admittance of GM crops.

COGEM chairman

Prof. dr. B.C.J. Zoeteman

SUMMARY

The minister of Housing, Spatial Planning and the Environment (VROM), Jacqueline Cramer, asked COGEM to draw up socio-economic criteria for the application of GMOs in agriculture. In her letter commissioning the assignment, the minister asks COGEM which socio-economic themes, including in any event, sustainability, play a part in activities involving GMOs in agriculture.

Building blocks for an assessment framework of the sustainability of GM crops

COGEM has identified and describes in this report a number of building blocks which could play a part in assessing the contribution that GM crops could make towards 'more sustainable' agriculture. Where this report refers to sustainability aspects this relates to social, economic and environmental aspects. These aspects are closely interrelated and cannot be seen as separate from one another.

While drawing up this report COGEM aimed to involve a broad range of expertise and to throw light on the differing approaches and perspectives. In arriving at this report, existing sustainability criteria were also looked at, such as those for palm oil, soy and biomass. The results of the Ministry of Agriculture, Nature and Food Quality (LNV) seminar on 9 June 2009 on re-evaluating the GMO assessment framework, have also been incorporated in this report and interviews were conducted with a number of experts in the area of agrarian development and sustainability.

Sustainability criteria specific to GMOs

Sustainable development is not a clear-cut, static concept but a dynamic one, and depends on the context (e.g. society, culture and religion) and the spirit of the age. What sustainable development means will also depend on what is considered to be acceptable from a socio-economic point of view and this can evolve over the course of time. How sustainability is defined changes as society changes, and as our knowledge and technological capabilities increase. What form sustainable agriculture takes can thus also differ from one country or region to another because different cultural and other values may be involved or because it is at a different stage of development.

All forms of sustainable development, however, relate not so much to the product, in this case the plant or agricultural crop itself, but to its application and use at a certain time and place. Because in many areas there is little or no difference between the application (production, cultivation) and use (import, processing, end product) of GM crops and conventional crops, this could mean that criteria applied to sustainable

agriculture could also be applied to GMOs, because these are the criteria which a crop must meet to be able to make a contribution towards a more sustainable form of agriculture. Unfortunately, sustainability criteria for agriculture have not yet been developed in a way which can be drawn upon here. Furthermore, this would be to overlook the exceptional position which GMOs have in relation to conventional (agricultural) produce in Europe. The reason for this exceptional position is the ethical and public objections which have been raised by certain groups in society regarding the process by which GMOs are created: the use of genetic modification. This is why criteria for the application of GMOs in agriculture have been specially formulated.

COGEM notes here that the introduction of an assessment of the sustainability aspects of GM crops could raise questions concerning the sustainability of certain conventional crops and cultivation methods which at present, are not assessed in this way. COGEM notes also that the rejection of a GM crop on the basis of socio-economic arguments, while these equally apply to conventional crops that are not subject to such criteria, could be met with incomprehension.

Conventional agriculture as a frame of reference

In the minister's letter to COGEM it is suggested that conventional agriculture be taken as a frame of reference. The term conventional agriculture does not refer to a form of agriculture which can be unequivocally defined and exists only in relation to so-called 'non-conventional' forms of agriculture, such as organic farming. What constitutes conventional agriculture may also differ from one country to another depending on what stage of development they are at and what techniques are available.
Although there are major differences between existing agricultural systems (organic and conventional), there are also similarities. In all cases it is essentially a matter of controlling (or trying to control) biological processes. Agriculture can generally be defined as the entirety of economic activities in which the natural environment is modified for the production of plants and animals intended for human use. Depending on the product, the production method and the level of prosperity and underlying values, a wide range of techniques and types of solutions are used to deal with agricultural problems. Whatever form of agriculture is applied this generally has an adverse impact on the existing environment and ecosystem, depending on the crop and the cultivation method used. This impact is largely accepted because the business of farming directly or indirectly provides society with food and is therefore seen as a necessity. Both conventional and organic forms of farming aim for sustainability, but do this in different ways.

In this report conventional agriculture has been taken as a frame of reference because this form of agriculture is most common. A general principle in drawing up these criteria was that GM crops in agriculture should meet as well, if not better, the criteria which apply to the present non-GM variants in conventional agriculture.

Nine criteria for the sustainable application of GM crops

COGEM has formulated nine themes and associated criteria which could serve as building blocks in an assessment framework on the socio-economic and sustainability aspects of GMOs:

THE PRODUCTION AND USE OF GM CROPS MUST CONTRIBUTE TO MORE SUSTAINABLE AGRICULTURE IN THE FORM OF:

BENEFIT TO SOCIETY

1. The production of GM crops leads to an increase in yield, contributes to harvest security or offers some other form of general benefit to society.

The elements involved here include: harvest security, food security, food quality, environmental benefit, cost saving, recreation.

ECONOMICS AND PROSPERITY

2. The production and use of GM crops contributes equally to local and overall prosperity and the economy and, where possible, leads to an improvement.

The elements involved here include: employment, efficiency of the production process, productivity and profit.

HEALTH AND WELFARE

3. The production and use of GM crops means that the health and welfare of workers, the local population and consumers remains at the same level and, where possible, improves.

The elements involved here include: human rights, the working environment and terms of employment.

LOCAL AND GENERAL FOOD SUPPLY

4. The production and use of GM crops means that the local food supply remains at the same level and, where possible, improves.

The elements involved here include: food security and fair trade.

CULTURAL HERITAGE

5. The production of GM crops offers the country or region concerned, if so desired, room to conserve and continue specific cultural heritage aspects or other local applications (such as building materials, medicines).

The elements involved here include: local applications and traditions, autonomy of the local population.

FREEDOM OF CHOICE

6. The consumer and the manufacturer's freedom of choice regarding GMO (or GMO-free) is safeguarded in the production and import of GM crops.

The elements involved here include: GMO (or GMO-free) labelling of products, product information, co-existence and innovation, and research freedom.

SAFETY

7. The admittance and assessment of GM crops in terms of safety to humans and the environment takes place in the country concerned in accordance with the legislation, on the basis of the international agreements in force concerning human and environmental safety.
The elements involved here include: food safety and environmental safety.

BIODIVERSITY

8. The production of GM crops does not a) lead to a reduction in the agrobiodiversity of the agricultural environment and where possible strengthens it, and b) damage protected or vulnerable biodiversity.
The elements involved here include: agrobiodiversity, protected or vulnerable biodiversity, places of origin of agricultural crops.

ENVIRONMENTAL QUALITY

9. The production and processing of GM crops means that a) the quality of the soil, surface water and groundwater, and air, does not deteriorate and, where possible, is improved and b) the emission of greenhouse gases along the entire chain (development, production, processing and transport) remains neutral or declines relative to conventional agriculture.
The elements involved here include: emissions of hazardous substances to the soil, surface water and air, soil fertility and resistance.

Practical considerations

Operationalization of the criteria drawn up goes beyond the scope of this report. In the preparation of this report COGEM has, however, indicated some points which should be taken into account when the criteria are further developed into an assessment framework at a later stage.

Measurable criteria

For the operationalization of the sustainability criteria it would be desirable that the indicators used to measure the criteria: a) are objectively measurable, and b) can be estimated in advance. Some of the aspects referred to will be more difficult to operationalize, such as the themes cultural heritage, or welfare. Welfare and prosperity are general terms which on further consideration may well differ per country, culture or even religion. Initially, a reporting requirement could apply for these aspects so that more information can be gathered. With the aid of this information a system can even-

tually be drawn up by which these aspects can be quantified. When European member states can decide individually about cultivation on their own territory, this step will be essential to limit major differences between the member states in the admittance of GM crops for cultivation.

To test the safety of GM crops, the EU and many countries outside Europe already have a risk assessment in which largely objectively measurable data are evaluated with regard to safety to humans and the environment. The results of these studies in terms of the impact of GM crops on the environment and the significance of the measured values in this research are still regularly the subject of discussion. This applies to various scientific studies which contradict one another as well as to any one study which can be interpreted in different ways. COGEM notes that when people already cannot agree on measurable facts, in practice the introduction of socio-economic criteria will be a complex task in which wide differences of interpretation could arise between EU countries.

Besides this, it is open to question whether the impact of the cultivation of a GM or non-GM crop on social, economic and environmental aspects, the three essential elements of sustainability, can always be predicted in advance. In estimating risks to health or the environment it is, to a certain extent, possible to make use of scientific studies and research. Other aspects, however, are more difficult to quantify in advance, particularly when they are closely connected, as with the three basic components of sustainability. Often assumptions have to be made with regard to one or more aspects of these elements. For GM crops which have already been cultivated for some time, such as soy and maize, there is already empirical data upon which such assumptions can be based. For new GM crops with different properties, the impact on socio-economic aspects, such as welfare, employment or local food production, will generally be much more difficult to estimate or quantify. Furthermore, the impact of the cultivation of a particular crop will also depend on the region or area where this takes place. The economic, environmental and social situation may vary per region. The present admittance procedure relates to permits for cultivation or import, irrespective of the location. The question is, therefore, whether a sustainability assessment for new crops can be carried out in advance or whether new applications must first be introduced on the basis of a qualitative estimate of the sustainability aspects in which monitoring of the socio-economic impact takes place to provide a more quantitative picture.

Distinction between import and cultivation

In this report a distinction has been made between those criteria which are mainly relevant to the cultivation of GM crops in Europe, and the cultivation of GM crops elsewhere in the world followed by import into Europe. There are several reasons for making this distinction. A particular theme may be less relevant because there is already legislation or regulations on that specific topic, as with safety for example, or because the theme is not (or no longer) a current topic of discussion, as with welfare and prosperity in Europe. The practical application of the criteria is another reason for making this distinction.

Criteria relevant to cultivation in Europe

The themes and discussion points which are most relevant to the debate on GM crops in Europe which have not yet been included in an assessment framework or regulated in any other way, are as follows:

- Benefit to society
- Economics and prosperity
- Cultural heritage

Safety, freedom of choice, biodiversity and environmental quality are also still topical and relevant to Europe. These aspects have already been laid down in legislation. Safety is the fundamental principle in the assessment of GM crops in Europe and will continue to be so. Freedom of choice is covered in the legislation through a labelling requirement, among other things. Biodiversity and environmental quality too, are largely laid down in the legislation. There are various initiatives on biodiversity, such as Natura 2000, which are intended to protect vulnerable areas of natural beauty in EU member states. The themes benefit to society, economics and prosperity, and cultural heritage are not covered in the legislation or regulations on GMOs. These can be further developed and operationalized if it is decided that they could play a part in the individual assessment by member states on the admittance of GM crop cultivation in their own territories. The themes health and welfare, and local food supply are generally no longer discussion topics in Europe.

Criteria relevant to cultivation elsewhere followed by import into Europe

All nine themes are relevant to cultivation outside Europe followed by import into Europe. The operationalization of a sustainability assessment for cultivation in Europe is less complex than the imposition of such requirements on countries outside the EU which export to Europe. In view of trade relations, as well as politically and legally, it is much more complex to draw up an assessment framework for sustainability for import, because other laws and rules apply outside Europe. A more ethical and political issue related to the introduction of an assessment framework for sustainability for countries outside the EU is the matter of whether this is actually desirable. Is the conservation of cultural heritage a choice to be made by the country itself or can it be used by importing countries as an argument?

In order to estimate the potential impact of the introduction of GM crops into the agriculture of other countries, the involvement of local stakeholders will always be very important. This is already done in a number of existing international initiatives such as the Round Table on Responsible Soy (RTRS) in which both experts and local stakeholders are involved. One option might be to support these initiatives and get involved in them until more experience has been gained within the European member states with regard to the use of sustainability criteria in the assessment of GM crops.

COGEM notes that if the various European member states were to gain experience in the operationalization of a number of sustainability criteria for crops cultivated in

their own territories, this could be a useful step in the process of moving towards a broader assessment in which import is also assessed in terms of sustainability.

CONTENTS

1

INTRODUCTION

The discussion about the admittance of genetically modified (GM) crops is high on the political agenda in Europe and the Netherlands. Both in the Dutch parliament and the European bodies in Brussels, there is dissatisfaction about the present European admittance procedures for GM crops and the deadlock in the decision-making process on permit applications. Ways to break this deadlock are being sought. Therefore it is being considered whether other criteria than just safety considerations can be used in the assessment and admittance of GM crops.

1.1 SAFETY DEBATE ON GMOS WEIGHED DOWN BY OTHER ARGUMENTS

The admittance of genetically modified organisms (GMOs) is regulated at a European level. A complete overview of the admittance procedures can be found on the website of the European Food Safety Authority (EFSA) and in the COGEM research report Dossier costs for GM crops.[1,2]

Based on the European legislation, GMOs may be admitted to the European market provided that they are found to be safe to humans, animals and the environment. Socio-economic aspects play no formal role under the present admittance procedure.[a]

A market application is submitted to the EFSA through one of the European member states. The European member states have access to the dossier and are given the opportunity to comment on it and make their objections known. During this phase discussion often arises about the interpretation of the data in the dossier and questions about the possible impact of GM crops in the long term. The EFSA then makes a recommendation to the European Commission (EC) which includes the comments of the member states. Based on the EFSA opinion, the EC draws up a draft decision on which the member states can vote. In practice, however, a qualified majority is seldom achieved during this voting round, partly because a number of countries systematically abstain from voting. When a qualified majority on a decision also cannot be reached in the European Council (Environmental Council or another Council of Ministers), the draft decision of the EC takes effect. This decision will generally be in line with the

a European Directive 2001/18 states for decisions where publication is a condition for application, that 15 Member States should be able to consult any committee they have established with a view to obtaining advice on the ethical implications of biotechnology. However, it later states that the administrative procedures in the Directive are not affected by this information.

opinion drawn up by the EFSA. A permit for cultivation, import or processing in Europe is then valid in all European member states. These permits are for 10 years.
If during the term of the permit a member state has sound reasons to assume that a GM crop constitutes a threat to the local safety of humans, animals or the environment, the member state can appeal under another procedure, known as the safeguard clause. The use or sale of the GM crop in the territory of this member state may be temporarily restricted or banned. A safeguard clause on the use or sale of a particular GM crop may only be instituted on the basis of new scientific information which shows that there is a risk to humans, animals or the environment. The EC must then evaluate whether the safeguard clause is sufficiently scientifically grounded. In practice, it turns to the EFSA for advice on this. To date, on the basis of the advice it has received, the Commission has, in all cases, concluded that the safeguard clause in question was insufficiently scientifically based and submitted a draft decision for the withdrawal of the protective measure to the Environmental Council. The Environmental Council has, however, with a qualified majority, repeatedly dismissed these Commission proposals with the result that the safeguard clause remained in force. In conclusion: the admittance of GM crops to Europe is a long-drawn-out and complex process, as a result of which the introduction of GM crops, particularly in terms of cultivation, has effectively come to a halt in Europe.

SITUATION REGARDING GENETICALLY MODIFIED MAIZE MON810

The genetically modified maize variety MON810 of the company Monsanto was admitted to the EU for cultivation in 1998. That same year a blocking minority of member states announced that it would vote against all GMO dossiers as long as the EU regulatory system was not thoroughly overhauled. In view of this the European Commission decided not to present any more dossiers to vote on. This resulted in an effective moratorium on the market admittance of GMOs in Europe. This moratorium was lifted again in April 2004 when the European Commission, following the completion of new EU rules on GMOs and partly under pressure of a WTO case which had been brought by the US, Canada and Argentina against the EU, decided once again to submit market admittance dossiers to be voted upon. Since then, however, a qualified majority for or against a dossier has never been achieved in any vote on an admittance dossier.

Maize variety MON810 already admitted has been grown in recent years in a number of countries, including France, Spain and Germany. Cultivation permits are valid for 10 years in the EU. In 2008 an application was submitted for an extension of the permit to grow MON810 in Europe. Additional information was submitted at the same time, in accordance with the present European directives. In the same year France announced a ban on the cultivation of GM maize MON810.[3] It instituted the safeguard clause. A number of other European countries, including Austria, Luxembourg and Greece, submitted safeguard clauses on this maize variety and other GMOs.[4] Other member states, including the Netherlands, have assessed the new data and reached the conclusion that there are no reasons to assume that the cultivation of MON810 represents a threat to

humans or the environment.[5,6] Nevertheless, the safeguard clause is still in force in a number of countries. In the European Council a qualified majority was not reached when a vote of the member states was taken on a forced lifting of the ban on the cultivation of MON810.[7] According to the latest reports, the EFSA has invited the stakeholders to hold a scientific discussion in September 2009 on the EFSA opinion document concerning the environmental risks of maize MON810.[8,9] Ultimately, what we see in Europe is that an extraordinary situation has arisen in which a GM crop is found to be both safe and unsafe. MON810 has been found to be safe for cultivation in the European Union (EU) on the basis of the legislation and regulations in force concerning the safety of humans, animals and the environment. The same GM crop, however is banned from cultivation in a number of EU member states because it is not considered to be safe by these member states.

There may well also be other, different arguments that are not based on safety, for voting not to allow market admittance or for abstaining from voting. These arguments could relate to fundamental objections or socio-economic aspects, such as an alleged lack of added value of GMOs, the matter of whether GMOs fit into the development of sustainable agriculture or local farming practices. These arguments are given no weight under the present admittance procedures, because they are not related to safety risks. The decision-making under the present admittance procedure, which is solely based on safety arguments, would seem to have ended up in deadlock partly because of this. In discussions about the European admittance procedure, questions are raised about whether aspects other than safety should also have a place in the assessment framework.

The Environmental Council of December 2008 therefore unanimously agreed to start a process to gain more insight into the socio-economic impact of the cultivation and introduction onto the market of GMOs. Providing an overview of arguments other than safety for the purposes of arriving at a broader assessment framework for GM crops thus has a two-fold purpose:
- To re-focus the safety discussion,
- To clarify the arguments for and against GM crops, and give them a place in the discussion.

1.2 ROOM FOR SOCIO-ECONOMIC ARGUMENTS

For the purposes of the Netherlands' contribution to the European discussion, the minister of Housing, Spatial Planning and the Environment (VROM), Jacqueline Cramer, asked COGEM to draw up socio-economic criteria to be able to assess what contribution GMOs could make to more sustainable agriculture. In her letter the minister asks

which socio-economic themes including, in any event, sustainability, could play a part in activities involving GMOs:

'The admittance of genetically modified organisms (GMOs) into the EU was discussed in the European context in 2008. During the discussion socio-economic aspects which might be connected with GMOs were mentioned and the role that these aspects could play in the assessment process. ... Member states have... until 1 January 2010 to send information on the socio-economic impact of GMOs to each other and the European Commission....'

'For the purposes of the Netherlands' contribution I would like to draw up an assessment framework on the socio-economic aspects of GMOs. My aim with the assessment framework is to create clarity about which socio-economic themes may be involved in activities relating to GMOs. ... By socio-economic aspects I am referring, in any event, to sustainability. I would therefore like to ask for your help in drawing up the assessment framework, by asking you to prepare a report on the socio-economic criteria for the application of GMOs.'

The minister requested that in drawing up an assessment framework, a distinction be made between those aspects which are involved in cultivation in Europe and elsewhere, and between cultivation and import.

'I would imagine, for example, that different socio-economic aspects will be connected with the cultivation of GMOs in the EU than elsewhere in the world, possibly followed by import into the EU.'

Finally, the minister refers to a number of existing reports and studies in which socio-economic criteria play a part.

'In this context I refer to the assessment framework for sustainable biomass. ...In your report you could, in so far as possible, provide a similar framework for GMOs. The frame of reference here might be conventional agriculture in which the criteria could be focused on at least equal or where possible improved sustainability.'

The full text of the letter from the minister can be found in Annex 1 to this report.
The reason for the request of the minister of Housing, Spatial Planning and the Environment (VROM) is the debate which is currently being conducted in Europe on the matter of what considerations, other than safety, should be given a place in the assessment of GM crops for admittance. Safety is already a prerequisite for the admittance of GMOs and is laid down in European directives and the national legislation of European member states. Safety is the underlying principle in the assessment of GM crops and will continue to be so. The central question is:
'What other considerations are raised in the public debate on GM crops and how can they be included in an assessment framework?'

1.3 THIS REPORT

This report was prepared by the subcommittee on Ethics and Societal Aspects with support from the subcommittee on Agricultural aspects of COGEM (see annex 4). COGEM has identified and describes in this report a number of building blocks which could play a part in assessing the contribution that GM crops could make towards more sustainable agriculture. The building blocks in this report are related to the commonly recurring key themes in the GMO debate.[10] Based on these key themes, criteria have been formulated for the contribution that GMOs could make to more sustainable agriculture in terms of social, economic and environmental aspects. These criteria are intended as input in a political and public process in which it is considered how sustainability aspects could be included in the assessment of GMOs. The operationalization of the criteria is not included in this report. This step will follow once consensus has been reached on the approach and a possible socio-economic assessment framework has been arrived at.
COGEM offers no opinion in this report on the matter of whether or not genetic modification fits within the concept of sustainable agriculture. This is a fundamental choice in which, among other things, social, cultural and religious convictions play a role. It is up to the politicians to find a balance between these things.
In drawing up this report COGEM aimed to incorporate a wide range of expertise and to throw light on the differing approaches and perspectives. Existing sustainability criteria were also looked at during the preparation of this report, such as those for palm oil, soy and biomass.[11,12,13] The results of the Ministry of Agriculture, Nature and Food Quality (LNV) seminar on 9 June 2009, on re-evaluating the GMO assessment framework were also included.[14] COGEM also conducted interviews with a number of experts in the area of agricultural development and sustainability (see annex 5).

The introduction in Chapter one provides the background to the minister's request. Chapter two outlines a frame of reference which could be used in the assessment of the sustainability aspects of GM crops. In Chapter three a number of recurring key themes in the gene tech debate are identified which could serve as building blocks for a socio-economic assessment framework. In the same chapter a link is also made between these key themes and the three essential elements of sustainable development – social, economic and environmental development – which, when in the right balance, will give an added value in terms of 'people, planet and profit'. The role of ethical and societal considerations is also introduced into the debate on GMOs. Chapter four provides nine building blocks which could be used in the application and use of GM crops, set out in the form of criteria. Where possible indicators have been provided for the criteria to make them measurable. A number of the criteria mainly apply to cultivation, others to import, or both. Some brief attention is devoted to these differences in this chapter.
The distinction between criteria for import and cultivation is further developed in Chapter five. In addition, some considerations are mentioned which could become

involved at the next step in the process; the operationalization of the criteria. Here the applicability or measurability, and the specific nature of the criteria, among other things, are considered.

2

FRAME OF REFERENCE FOR GMO SUSTAINABILITY CRITERIA IN AGRICULTURE

The minister's letter commissioning this report refers to socio-economic aspects including sustainability. Socio-economic aspects are defined in various ways, depending on the context. COGEM considers environmental aspects to be an intrinsic part of the socio-economic dimension of sustainable development. Where this report refers to sustainability aspects, this covers both the socio-economic and the environmental aspects. A number of other, more ethical and public interest considerations which have an important role in the European discussion on GMOs have also been taken into account when drawing up criteria.

2.1 SUSTAINABLE AGRICULTURE IS TIME AND CONTEXT-DEPENDENT

Over the past ten years sustainability and sustainable development have become key considerations in almost all sectors. Because of the dynamic nature of sustainability, the term 'more sustainable' has gradually started to be used to refer to the process of sustainable development. The breadth of this topic, which sometimes covers everything that is considered socio-economically desirable, can make its implementation and operationalization complex. It is therefore important to set out a clear framework which shows what is meant by 'more sustainable' and how this can be tested. There are numerous definitions of sustainability which, depending on the context, are applied in different ways to particular developments. A common definition of sustainable development is the definition taken from the Brundtland report:[15]

'Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

The Brundtland report set out the coherent development of the social, environmental and economic aspects of society as the three key components in sustainable development. This was later boiled down to the terms: people, planet and profit. To be able to include social benefit in the equation, alongside economic profit, at the world summit on sustainable development in Johannesburg in 2002, the P of Profit was changed to Prosperity.

The Dutch government further defined the environmental aspect of sustainable development in the fourth National Environmental Policy Plan (NMP4),[16] which states:

'Environmental policy – here and now, but also later and elsewhere – should help to support life which is safe and healthy, living in an attractive environment surrounded by a robust natural ecosystem, without damaging worldwide biodiversity or depleting natural resources'.

The Dutch government's long term vision on European agricultural and rural policy in the future, places sustainability in the context of agriculture as follows:[17]

'Sustainable development aims to strike a balance between economic, environmental and social development. This is not just about finding that balance 'here and now' but also internationally, with particular consideration of developing countries, and 'later' for future generations. Values which are considered important to the Dutch population, such as nature and the environment, the landscape and animal welfare, must be safeguarded in this development. These values are important to soil users too, as a production factor; as they will want to protect the soil, water, natural biodiversity and agrobiodiversity from depletion, erosion, groundwater depletion and eutrophication, to be able to continue to produce. The art is in finding a balance whereby the market mechanism is strengthened while at the same time agricultural production becomes more sustainable...'

What form sustainable development takes will also depend on what is considered to be acceptable from a socio-economic viewpoint and this can evolve over the course of time. Sustainable development is thus not a clear-cut, static concept but a dynamic one, and depends on the context (e.g. society, culture and religion) and the spirit of the age. The nature of the definition of sustainability changes as society changes, and also as our knowledge and technological capabilities increase. What was seen as sustainable 10 to 15 years ago, may now be considered outdated, based on assumptions which on further examination were found to be faulty, or relate to goals which with hindsight were either not realistic or not ambitious enough. Advances in knowledge or technology can enable solutions which were not even thought possible ten years ago.[18]
What form sustainable agriculture may take could also differ from one country or region to another because importance is attached to different cultural values. All forms of sustainable development, however, relate not so much to the product, in this case plants or agricultural crops, but to its application and use at a certain time and place.

2.2 SUSTAINABLE DEVELOPMENT IN RELATION TO APPLICATION AND USE

Existing frameworks to assess sustainability in agriculture are mainly based on the way in which the production and use of a plant or crop takes place. Here the properties of

the product itself may, to some extent, have the potential to contribute to its sustainable production or use. In other words, both the *production method* and the *use* are measured against a set of criteria relating to its social, economic and environmental sustainability. GMOs could also be viewed in this way.

For GM crops this would mean looking at the production (cultivation) and use (import, processing) of the GM crop. The assessment framework for sustainable biomass, also known as the *Cramer criteria*, looks at the way in which biomass is produced and how it is then used or processed in relation to the use of fossil fuels.[13] Viewed from this perspective, GM crops which are cultivated for the purpose of biomass could also be assessed on the basis of the Cramer Criteria for sustainable biomass.[b] Because in many areas there is little or no difference between the application (production, cultivation) and use (import, processing, end product as food or animal feed) of GM crops and conventional crops, this could mean that criteria applied to sustainable agriculture could also be applied to GMOs. Unfortunately, sustainability criteria for agriculture have not yet been developed in a way which can be referred to here. Furthermore, this would be to overlook the exceptional position which GMOs have in relation to conventional (agricultural) produce in Europe. The reason for this exceptional position is the ethical and public interest objections which have been raised regarding the process by which GMOs are created: genetic modification. Various guidelines and studies have been published on sustainability aspects in agriculture in general, but only in a few cases have these been specified and operationalized, e.g. for soy and biomass. COGEM observes that the reason for drawing up sustainability criteria specifically for GMOs lies not in any difference in the production or use of these crops compared with conventional crops. The criteria for GMOs are being made explicit specifically because GMOs are surrounded by public controversy.[19, 10]

The European Group on Ethics (EGE) stated that all 'products' of new and existing agricultural techniques, and not just the products of recombinant DNA techniques, should be tested in terms of sustainability.[20] At present GMOs, and therefore GM crops too, are an exceptional case which is reflected in a dedicated safety assessment. This safety assessment does not apply to other crops which have been created by breeding techniques which did not involve any genetic modification. If only GMOs are to be tested in terms of sustainability, in theory, a GM crop could be rejected for sustainability reasons while a similar conventional crop is admitted even though it also fails to meet the prescribed sustainability criteria.

COGEM notes here that the introduction of an assessment of the sustainability aspects of GM crops could raise questions concerning the sustainability of certain conventional crops and cultivation methods which, at present, are not subject to any such assessment.

b The Cramer criteria make no reference to the applicability of the criteria to GMOs because of the dissension on the matter of whether GMOs can fit within the concept of sustainability or not.

2.3 CONVENTIONAL AGRICULTURAL SYSTEMS AS A FRAME OF REFERENCE

A development or product is almost always more or less sustainable relative to something else. The use of less, or less harmful, crop protection products is considered to be more sustainable, for example, but no specific quantity or threshold value has been defined which labels its use as 'sustainable'. This nevertheless raises the question of what is sustainable agriculture, actually, and what system of farming do we want or should we be aiming for? Although there is global agreement on this, ideas on what form the answer to this question should take are extremely wide ranging and formed by economic, social, cultural and religious considerations, among other things. COGEM adopts no position on this, in accordance with its monitoring - and therefore non advisory - role in relation to the ethical and public interest aspects of GMOs.

The minister's letter suggests adopting conventional agriculture as a frame of reference. The term 'conventional agriculture' does not refer to a form of agriculture which can be unequivocally defined and exists only in relation to 'non-conventional' forms of agriculture. In the past we could speak of conventional agriculture, integrated agriculture and organic agriculture. Now that integrated agriculture has largely been absorbed into conventional agriculture, in the Netherlands there is only conventional agriculture and organic agriculture. What constitutes conventional agriculture may also differ from one country to another, depending on what stage of development they are at and what techniques are available.

Although there are major differences between agricultural systems, there are also similarities. In all cases it is a matter of controlling (or trying to control) organic processes. Agriculture can generally be defined as the entirety of activities in which the natural environment is modified for the production of plants and animals intended for human consumption. Depending on the product, the production method and the level of prosperity and underlying values, a wide range of techniques and types of solutions are used to deal with agricultural problems. Sustainability is the aim of both conventional and organic farming, but this is approached in different ways.[21,22,23]

Because an assessment framework for the application of GMOs is being sought, COGEM will initially take conventional agriculture as its frame of reference, as this is the most common form.[c] A general principle in drawing up the criteria is that GM crops in agriculture should meet as well, if not better, the same criteria which apply to non-GM variants in conventional agriculture.

c In the future it may well also be possible to produce components which were previously chemically produced, such as biofuels or pharmaceutical ingredients, in GM crops. In this case existing or conventional production methods would provide the frame of reference. The present GM crops are mainly aimed at improving agronomic properties. Therefore conventional agriculture will be taken as the frame of reference in this report.

2.4 ENVIRONMENTAL IMPACT OF CONVENTIONAL FARMING SYSTEMS

Research on the effect of various farming systems on the environment has been going on for a long time. Depending on the agricultural and cultivation system used, the business of farming has generally always had an adverse impact on the existing environment and ecosystem. This influence is largely accepted because the business of farming directly or indirectly meets our primary need for food, and is therefore seen as a necessity. There is an ongoing debate about which method of farming is least harmful to the environment or is the most sustainable. Determining the impact of agriculture on the environment, however, is a complex matter, and thus the results of such studies are seldom conclusive. This discussion also includes the impact of GM agriculture on the environment. Research is carried out on the impact of GMOs on the environment. Those for and against point out the positive or negative effects of GMOs in agriculture. Sometimes even making reference to the same research reports or articles.[24,25] Damage to the ecosystem caused by monocultures and large-scale farming are regularly associated with the cultivation of GM crops, such as soy. Whether these effects can be directly attributed to GM crops or not, is unclear.[26] Maize, as well as soy in South America, were also cultivated as monocultures long before the arrival of GM varieties. The planting of monocultures is primarily driven by economic factors. When the cultivation of a crop becomes less labour intensive, requiring less maintenance, this can help to facilitate monocultures. Besides the negative associations and studies, GM crops are also known to have positive effects on the ecosystem. The cultivation of herbicide-tolerant crops, for example, requires little or no soil tillage which can have a positive effect on soil micro-organisms and help to limit or prevent harmful effects such as soil erosion.[27]
With a growing world population and the growing demand for food, research on the differences in impact of the various farming methods will continue, along with the quest for more sustainable methods. At the same time, it will be investigated how, and to what extent, GM crops can contribute to this.

2.5 EMERGENCE OF GMOS IN INDUSTRIALIZED AGRICULTURE

The emergence of genetic modification as used in agriculture is linked to the process of industrialization. The industrialization of agriculture was initially characterized by the mechanisation of farming in which the physical labour of people or animals was increasingly replaced by machinery. Working the land thus became less labour intensive and as a result farming could be scaled up and higher yields achieved. The use of chemical crop protection products to eliminate weeds, fungal diseases and insect pests increased harvest security. Not only were the farming processes optimized, but the crops, too. First, only through classical cultivation and later also with the aid of modern biotechnology techniques, such as genetic modification.

In the plant breeding process, the desired properties are selected with the aim that future generations will also have these favourable properties. The plant breeder, whether using classic cultivation or modern biotechnology techniques, is therefore the designer of this plant with its new properties. These properties may well only be exhibited during the application and use of the crops, but their impact has already been partly determined in the previous design and development phase. The intentions and the decisions made during the development of a product, technique or plant and which constitute an advance for later use, are also referred to as the 'script' of a technology. [28, 29, 30, 31, 32]
The script is incorporated into the design as an implicit instruction. This instruction is 'written' in the development phase by making specific decisions which are influenced by cultural, societal or religious values and the power relations which apply. A technology's influence therefore forms an inherent part of the technology itself. Seen from this perspective, technology is therefore not a neutral instrument, but reflects the prevailing social and technical dimensions.[29] In *'Do artifacts have politics'* Langdon Winner states that it is because of technology that a certain form of 'politics' is pursued.[28] The script of a technology or product, however, is not unchanging. Winner emphasizes that technological innovations can also offer prospects; that in another environment they can be used for different purposes, that over the course of time they acquire a different function or can be used for or by a different target group. In short: technological products reflect not only power relations (in which event they would be politically neutral, which Winner contests) but, in theory at least, they also offer opportunities to apply 'politics' through the specific way in which they are designed.
In the breeding process of new plant varieties an effort is made, consciously or unconsciously, to move towards a certain type of use or user. This use may be directly linked to the property of the plant, such as resistance to harmful insects (European corn borer), the production of medicines (pharma crops), foodstuffs ('golden rice') or a crop that is suitable for soil remediation or water treatment (phytoremediation). The property may be aimed at later users or consumers (e.g. seedless grapes). But the design may also have indirect implications for the later use which is related to the type of agricultural system in which the crop can be used. A crop that requires less, or less harmful, crop protection or maintenance facilitates up-scaling and thus a higher yield and more profit for the producer.[20] Conversely, a higher yield per hectare, through less yield loss due to pests and diseases, makes it less imperative to increase the area under cultivation.

IT CUTS BOTH WAYS

In a number of member states in Europe there is great public opposition to GMOs.[33] Questions about the safety and unforeseen harmful effects on the environment due to the cultivation of GM crops have led to a long moratorium on them. Besides fundamental objections based on

health and environmental risks, one recurring argument is that the GM crops currently cultivated are only aimed at increasing the profits of a number of big businesses and make no contribution to more sustainable agriculture, or are of any direct benefit to consumers. Although some are fundamentally opposed to GM crops, others argue for the inclusion of local skills, needs, economies, cultures and ecosystem when setting the agenda ('script') for the development of GM crops. According to these people, the scientific research agenda should be oriented more towards local priorities and capabilities.[34]

The exceptional nature of GMOs, due to their controversial place in society, means that because of the separate legislation, considerable costs are involved to provide the necessary data required for the safety assessment.[2] The cost of these mandatory studies is so high that only large corporations have thus far been able to undertake development and commercialization. The investment must be earned back, as a result of which it is more likely that crops which can be cultivated on a large scale will be selected rather than those which can be locally grown on a small scale. This makes it difficult to focus the biotechnological research agenda on small local applications. Furthermore, during the years of the moratorium Dutch plant breeding organisations have withdrawn from the development of GM crops. This was brought about by the effective European moratorium and the poor prospects for the sale of GM crops in the European market. Research into genetic modification in agriculture was also cut back in Europe. A number of largely foreign multinationals have taken the lead in the development GM crops. In view of the recently announced cultivation bans, it would appear that a number of European countries have decided to further withdraw from the development of new GM crops. In this way the opportunities for exercising influence over the direction in which biotechnology develops in the rest of the world have also been reduced. Partly because of the high cost of the admittance procedure for GM crops for cultivation, import and processing, it is at present almost exclusively multinationals that are capable of bringing GM crops onto the market. This will further reinforce the negative image of GM crops that some people hold, together with the fear that one or more large multinationals will take over the entire food chain. As a result, the application of GM crops is, in the first place, associated with industrialized and large-scale farming and not with a potential contribution to sustainable development.

The presence of a script that provides an advance for later use is not specific to GM crops but applies to all cultivated crops which are used in horticulture and farming. However, the development opportunities for GM crops are far greater and more far-reaching than will ever be possible with conventional breeding because species boundaries can be crossed. This may well bring risks to mankind and the environment. Possibly unforeseen, negative consequences is therefore one of the reasons why there is legislation to ensure the safety of GMOs to humans and the environment. Nevertheless, the design possibilities offered by GM crops may well have more potential than conventional crops in helping to make agriculture and areas of society more sustainable.

2.6 THE APPLICATION OF GMOS IN OTHER AGRICULTURAL SYSTEMS

Genetic modification and GM crops were created and first applied in industrialized agriculture and are therefore closely linked to one another. Whether that link is inextricable or not, is open to question. It may also be asked whether the type of use of GM crops can always be envisaged in advance. Where this relates to the cultivation of known crops, such as maize, cotton or soy, people generally have a clear picture of the industrial agricultural practices that this involves. A lot less is generally known about the small scale application of these crops. It may furthermore be expected that in the future other types of GM crops will also appear on the market whose use may perhaps be less easy to estimate in advance, such as pharma crops or GM flowers.
It may be concluded that the script of biotechnology applications in agriculture plays an indispensable role in the development of GM crops, which is then later expressed in the way it is applied in the cultivation, import and processing of such crops. By labelling the script as unchanging, GM crops are, in some cases, considered as inherently having the negative effects of large-scale agriculture and monocultures and should thus, by definition, be rejected. This brings the discussion on the use of GM crops in agriculture to an impasse. This is shown, among other things, by the fact that in various reports on sustainability criteria for products and processes in agriculture, such as soy production[d] (RTSS)[12], palm oil (RSPO)[11], biomass *('Cramer criteria')*[13] or wood production (FSC)[35], (PEFC)[36], GMOs are specifically excluded because there are fundamental differences of opinion on the matter of whether GMOs fit within the concept of sustainability or not.

In this report COGEM too, leaves aside the fundamental questions involved in the debate for and against. This report looks at what conditions GM crops should meet to be able to contribute to more sustainable agriculture in the various existing farming systems. The assessment of GMOs and their application in agriculture other than in terms of their safety, such as the socio-economic aspects, will also be partly determined by the degree to which they support the development of the agricultural system in a particular direction. The question then is not whether a GM crop is sustainable, but whether it is more sustainable across the whole chain, from cultivation to processing and end product.

d The discussion on the sustainability criteria for sustainable soy production is still ongoing. Among the subjects under discussion is whether or not GMOs should be excluded from these criteria. A vote will be taken on this during the course of 2009 at the Round Table on Sustainable Soy (RTSS).

3

BUILDING BLOCKS FOR A SOCIO-ECONOMIC ASSESSMENT FRAMEWORK FOR GMOs

Before criteria can be formulated for the sustainable use of GMOs in agriculture, it must first be determined what components or building blocks these criteria need to include. For this it is not necessary to start at the beginning. A look back at previously published COGEM reports can provide a starting point in determining what other themes, besides safety, could play a part in an assessment framework for GMOs.

3.1 KEY THEMES IN THE GENE TECHNOLOGY DEBATE

In 2007 COGEM published a report in which an analysis was made of the recurring themes and arguments in the gene technology debate.[10] These provide a starting point when considering the question of what aspects, as a totality, need to be taken into account when genetic modification is applied.
The following six topics or key themes constantly recur in the debate on gene technology: safety, health and welfare, social relationships, freedom of choice and trust, nature and the integrity of life, as well as sustainability. A number of these themes have a direct relationship with socio-economic aspects, others relate to nature and the environment (the environmental sustainability component). Altogether they cover the theme of sustainability in general, as well as its essential constituent elements: people, planet and profit.

3.1.1 SUSTAINABILITY AS A COMMON THEME

Sustainability is about aiming for maximum synergy between humankind, the environment and the economy when new developments (including new technological developments) take place in society. At the same time, of course, this must also be to the benefit of each of the three elements which make up sustainable development. Strengthening the positive effects of a new technology on humankind, the environment and the economy. These effects could include food security, health, welfare and maintaining a robust ecosystem. Adverse effects of such applications, such as defor-

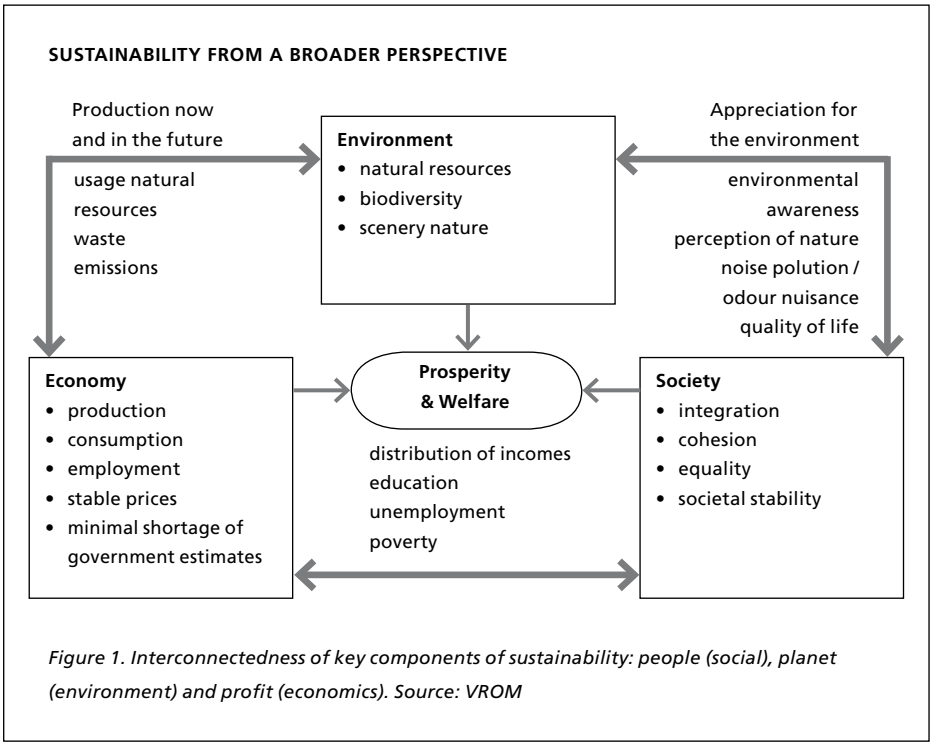

Figure 1. Interconnectedness of key components of sustainability: people (social), planet (environment) and profit (economics). Source: VROM

estation or the loss of biodiversity and employment, leading to a worsening of working conditions or poverty, however, should be avoided. Sustainability criteria provide a framework for assessing the effects of new developments. The criteria in this report are based on themes which have arisen out of the public debate on gene technology: safety, health and welfare, social relationships, freedom of choice and trust, nature and the integrity of life. These themes to some extent also reflect the values of society. An assessment based on sustainability criteria as formulated in this report will therefore provide a picture of how these values may be attacked or reinforced by new applications for GM crops in agriculture.

In the sections which follow the three elements of sustainability will be further considered with a view to the development of assessment criteria for GMOs. It should be noted that these three elements should not be seen as separate from one another, but as interlinked and impacting upon one another. The criteria drawn up in the next chapter therefore cannot be linked to just one of the three elements. Without a healthy and robust ecosystem and sustainable farming practices, there can also be no long term benefit in the socio-economic sphere. The interconnectedness of the elements people, planet and profit, or prosperity, for example, was underlined in the policy document published by the Netherlands Ministry of Housing, Spatial Planning and the Environ-

ment (VROM) in 1999 *(see Figure 1)*.[37] Besides the elements in Figure 1, health is also an important factor in the debate on GMOs.

3.1.2 SOCIAL SUSTAINABILITY

Social sustainability is linked to the just and fair distribution of food, work, income and housing, as well as healthcare, education and provision for old age. Social sustainability can be subdivided into a cultural, social and political component.[18] The cultural component relates to widely held values in society, such as justice, autonomy (freedom of choice) and prevailing views about nature and what is natural. The social component is linked to social relationships and social cohesion within the society, which is expressed in social safety nets, healthcare and employment, among other things. The opportunity and willingness of various population groups to join or participate with innovations also comes under social sustainability. Innovations which increase the access of various groups in society to work, as well as to the public and cultural life of the society, may also be considered as social sustainability. The third component of social sustainability is politics. This relates to the way in which decisions about sustainable developments are taken; on the basis of power, public participation and democratic principles. Openness, transparency and the involvement of stakeholders can help to increase public acceptance of biotechnological innovations. Providing information, encouraging research and education, and monitoring the safety of citizens, also come under the political element.

3.1.3 ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability relates to having and maintaining a robust ecosystem. As indicated above, environmental sustainability is also important to soil users and therefore closely connected with social and economic sustainability.
Environmental sustainability in agriculture means that a specific agricultural system can continue to be used now and in the future without causing irreversible damage to the ecosystem. Environmental sustainability centres on the relationship between the natural environment and maintaining the structure of the ecosystem. This also covers biodiversity, protection of vulnerable areas and preventing pollution and the depletion of resources. Good stewardship of the environment is essential to ensuring production security and quality in the long term. Here too, this aspect applies not only to the ecosystem in the Netherlands but also elsewhere. In the Fourth National Environmental Policy Plan (NMP4) is it emphasized that sustainability does not end at national borders.[16] The Netherlands and other western countries make a substantial claim on natural resources and biodiversity elsewhere in the world. With the import of agricultural produce into the Netherlands, this has an impact on the environment in the exporting countries and natural resources in the country concerned are used up. In

this way the Netherlands may also be indirectly contributing to damaging the ecosystem in the producing country, through soil erosion, water extraction, eutrophication or soil depletion. What environmental sustainability does not mean, however, is that countries must reduce their environmental footprint at all costs. The NMP4 has the following to say about this:

'This is not about reducing the Dutch 'footprint' elsewhere by all possible means. Having a footprint is inherent to international trade. A properly functioning system of international trade will contribute to better socio-economic conditions worldwide. It is a matter of making that footprint more sustainable...'

In the report 'Prospects for GM crops in sustainable agriculture' COGEM investigated what the potential environmental and economic impact of existing GM crops might be on Dutch agriculture.[41] To make such an estimation for another country with its own ecosystem, climate, culture and farming practices, however, would be much more complex.

3.1.4 ECONOMIC SUSTAINABILITY

Economic sustainability, in the first place, implies that a development in the economic sense is feasible and can be maintained without causing irreversible damage to the economy. The ultimate goal here, however, is not just economic gain (profit), but also social gain in the form of affluence for as large a share of the world population as possible, both now and in the future (prosperity). Economic and social sustainability are closely related to one another in this way.
Besides profit, trade relations, economic stability and prosperity, innovation also plays a part in economic sustainability. Innovation is essential to be able to create a sustainable economy, now and in the future. Through innovation in biotechnology, both conventional and GM crops can be further developed and optimized so that they are as well adapted as possible to changes in the climate, environment and world population. Sustainability aspects, in the sense of effectiveness and usability in the long term, can be taken into account during the innovation or development process. For GM crops this might be long-lasting resistance properties which cannot easily be overcome. Patents linked to research and innovation are another aspect. These can strengthen but also restrict or even impede work on innovation. Patents can involve high costs and lead to restrictions on experimental research on crops.

3.2 ETHICAL CONSIDERATIONS IN SOCIETY

The foregoing sections covered the various sustainability aspects which are mentioned in connection with the use of GMOs. But ethical arguments also constitute an intrinsic

part of the debate on genetic modification. These play a role when considering the various socio-economic aspects of genetic modification. Fundamental objections to genetic modification and its application cannot be removed by instituting socio-economic criteria. Fundamental ethical considerations therefore have not been included in the criteria drawn up in this report. What can be achieved by including socio-economic criteria in the assessment, however, is more balance when weighing up the benefits and risks, or utility and need, for GM crops.

Consideration of the benefits and risks when evaluating technological or biotechnological applications is not new. In 2003 COGEM wrote the report 'Towards an integrated framework for the assessment of social and ethical issues in modern biotechnology'(IETK).[38] The IETK is a tool which can be used to make the ethical and social considerations which touch upon biotechnological developments more transparent and coherent in the evaluation of biotechnological research in general, and genetic modification in particular. Furthermore, the IETK can lend structure to the ongoing public debate on the ethical acceptability of existing and future biotechnology developments. In its IETK report COGEM argued for a careful weighing of the benefits and risks (proportionality principle). Ethical assessment should not be limited to a consideration of only the economic benefits in relation to the scientific risks to humans and the environment. All society's goals, such as employment and reducing environmental pollution, and all the drawbacks, such as reducing genetic diversity and the integrity of organisms, need to be included in any such evaluation.

In other European countries too, it has been investigated how considerations other than safety can be included in the evaluation of GMOs. In Norway, sustainability, public interest and ethics are specifically referred to in the Gene Technology Act.[39] A discussion paper of the Norwegian Biotechnology Advisory Board[40] was published in 2000 on the inclusion of these aspects in the evaluation of GMOs. This paper includes lists of questions which are intended to identify the sustainability, public interest and ethical aspects of individual applications. Both the IETK and the Norwegian discussion paper were mainly concerned with values related to sustainability and the public interest, which has to be fostered and protected. Many of these values recur in this report and are specifically referred to as criteria.

The basic principle in the IETK report and the checklist of the Norwegian advisory board is that all biotechnology applications should at least meet certain basic requirements, such as the statutorily prescribed threshold values, which in any event provide for the safety of humans, animals and the environment in relation to GMOs. The IETK report provides a first step towards a risk/benefit table which also takes into account other social goals (see Annex 3). In the regulatory context too, this table (or form) could perhaps constitute a first step towards operationalization of the proposed criteria.

3.3 PROSPECTS FOR GM CROPS IN A SUSTAINABLE FORM OF DUTCH AGRICULTURE

At the request of the Minister of the Netherlands Ministry of Housing, Spatial Planning and the Environment (VROM), in 2008 COGEM published a report on the environmental and economic impact of GM crops on Dutch agriculture. In 'Prospects for GM crops in sustainable agriculture' COGEM investigated how existing GM crops could contribute to making Dutch agriculture more sustainable.41 The focus of this report was on the economic and environmental impact of the application of GMOs in agriculture and what contribution these GM crops could make to Dutch agriculture. COGEM concluded that there are currently GM crops in development which, from both an economic and an environmental point of view, could be useful for the development of a more sustainable form of Dutch agriculture. However, given the small area of land used for agriculture in the Netherlands, the GM crops currently available are not particularly attractive for Dutch farming. Furthermore, the properties which have so far been added offer few advantages to the Dutch arable farmer.

3.3.1 SUSTAINABILITY GOES BEYOND NATIONAL BORDERS

In the report on the contribution made by GM crops to national agriculture, COGEM indicated that any benefits of GM crops in terms of more sustainable agriculture abroad could also help to reduce the Netherlands' environmental footprint. Agricultural crops produced elsewhere are imported into the Netherlands in considerable quantities as food or livestock feed. In this way, the Netherlands has an indirect responsibility for making agriculture more sustainable in countries which offer their products for import into the Netherlands. This aspect should be taken into account in an evaluation of what contribution GM crops could make towards making agriculture more sustainable. The minister also raised this point in her letter to COGEM requesting this report. She commented that in the cultivation of GMOs elsewhere in the world, possibly followed by import into the EU, other socio-economic aspects may possibly play a role than in their cultivation within the EU itself.
In this report a number of aspects will be addressed which were also covered in 'Prospects for GM crops in sustainable agriculture', but this time based on a wider link between the social, environmental and economic aspects of sustainability. This report will also not be limited just to Dutch agriculture, but take more of a worldwide focus.

4

NINE CRITERIA FOR THE SUSTAINABLE APPLICATION OF GM CROPS

It is not often that we stop to think about what conditions are necessary to be able to combine economic, social and environmental goals in practice. Conflicts between these goals however, such as environmental and economic interests, can easily arise. More sustainable agriculture means that such differences must be overcome. This can only take place when the stakeholders are prepared to adopt an attitude in which they are willing to consider one another's arguments and work towards their common interests.[42,43] Identifying themes is a useful tool in making all the interests more visible and thus all the stakeholders involved, and involving them in the decision-making process.
In this chapter, nine themes and associated criteria are formulated based on previous COGEM reports and existing sustainability criteria, which could serve as building blocks for an assessment framework of the sustainability aspects of GMOs. It has been considered to what extent existing sustainability criteria can be applied to the application of GMOs in agriculture, or even be made specific to GMOs. The sequence of the criteria in the discussion is arbitrary and does not indicate any particular order of importance. However, we have begun with criteria on which few agreements have yet been made in the EU.

THE PRODUCTION AND USE OF GM CROPS MUST CONTRIBUTE TO MORE SUSTAINABLE AGRICULTURE IN THE FORM OF:

BENEFIT TO SOCIETY

1. The production of GM crops leads to an increase in yield, contributes to harvest security or offers some other form of general benefit to society.

The elements involved here include: harvest security, food security, food quality, environmental benefit, cost saving, recreation.

ECONOMICS AND PROSPERITY

2. The production and use of GM crops contributes equally to local and general prosperity and the economy and, where possible, leads to an improvement.

The elements involved here include: employment, efficiency of the production process, productivity and profit.

HEALTH AND WELFARE

3. The production and use of GM crops means that the health and welfare of workers, the local population and consumers remains at the same level and, where possible, improves.
The elements involved here include: human rights and conditions at work.

LOCAL AND GENERAL FOOD SUPPLY

4. The production and use of GM crops means that the local food supply remains at the same level and, where possible, improves.
The elements involved here include: food security and fair trade.

CULTURAL HERITAGE

5. The production of GM crops offers room, if so desired, for the country or region concerned to conserve and continue specific cultural heritage aspects or other local applications (such as building materials, medicines).
The elements involved here include: local applications and traditions, autonomy of the local population.

FREEDOM OF CHOICE

6. Consumers and manufacturers' freedom of choice regarding GMO (or GMO-free) is safeguarded in the production and import of GM crops.
The elements involved here include: GMO (or GMO-free) labelling of products, product information, co-existence and innovation, and research freedom.

SAFETY

7. The admittance and assessment of GM crops in terms of safety to humans and the environment takes place in the country concerned in accordance with the legislation on the basis of the international agreements in force concerning human and environmental safety.
The elements involved here include: food safety and environmental safety.

BIODIVERSITY

8. The production of GM crops does not lead to a) a reduction in the agrobiodiversity of the agricultural environment and where possible strengthens it, and b) damage to protected or vulnerable biodiversity.
The elements involved here include: agrobiodiversity, protected or vulnerable biodiversity, places of origin of agricultural crops.

ENVIRONMENTAL QUALITY

9. The production and processing of GM crops means that a) the quality of the soil, surface and groundwater, and air, does not deteriorate and, where possible, improves and b) the emission of greenhouse gases along the entire chain (development, production, processing and transport) remains neutral or declines relative to conventional agriculture.

The elements involved here include: emissions of hazardous substances to the soil, surface water and air, soil fertility and disease resistance.

In the sections which follow these themes and their associated evaluation criteria will be elaborated upon, and the difference between cultivation in Europe and cultivation elsewhere in the world followed by import into Europe, will also be considered. The reasons for this are that other aspects will apply to cultivation in Europe than to import into Europe from other countries. Operationalization of the criteria where cultivation takes place elsewhere followed by import into Europe is also more complex because the national legislation of the exporting country and international legislation affecting trade relations, for example, also have to be taken into account. This distinction will be examined further in this chapter. Where possible, indicators for the criteria will be identified which could provide a measurable means of assessment. These indicators constitute a first step and are not exhaustive.

4.1 BENEFIT TO SOCIETY

THEME 1: BENEFIT TO SOCIETY

Criterion 1: The production of GM crops leads to an increase in yield/contributes to harvest security or offers some other form of general benefit to society.

Indicators: harvest security, food security, food quality, production of high quality substances (biofuels, medicines), recreation, etc.

This theme is considered separately because every application must have a positive effect on this, and it is also connected with a number of other themes, such as health and welfare, prosperity and economics, and the environment. With each of these themes food security, reduced use of crop protection products or high quality applications, among other things, are referred to as things which could be considered as a benefit to society. Public acceptance is crucial to the sustainable development of GM crops. The development and production of the present GM crops is aimed mainly at achieving an agronomic benefit in the form of increased production or harvest security. The development and introduction onto the market of a GM crop also involves considerable cost.[44] This cost must be earned back and plays a part in the selection of the particular properties that are introduced into GM crops. Indirectly, harvest security or increased yield may well have a benefit to the consumer in terms of food security, but this is not immediately apparent to the western consumer. Many reports have been published, sometimes reaching differing conclusions, about the degree to which GM crops increase yield and improve harvest security, as well as their environmental impact.[45,25] Determining the impact of GM crops appears to be complex because there

are many different influencing factors, such as climate (or climate change), different agricultural systems and the frame of reference adopted. As a result, and owing to the lack of specific (visible) benefits to the consumer, questions are regularly raised by the public about the general usefulness and benefit to society of GM crops.
In general terms, it may be said that the development and application of GM crops should serve a purpose which is considered to be beneficial to society. As with sustainability, there are three interconnected elements which impact upon one another: the benefit to humankind, the environment and the economy. Specification of the social, environmental or economic benefits of GM crops is a criterion which is specific to GMOs, because this is not something which requires justification for conventional crops. Conventional farming is generally considered to be beneficial because it directly or indirectly contributes to the food supply. GM crops are controversial in society and raise questions about the potential risks to humans and the environment. This is one of the reasons why GM crops, unlike conventional crops, have to offer something more before they will be accepted by consumers. A clearer explanation of the benefit to society could help to support this.

4.1.1 SOCIAL BENEFIT TO SOCIETY

Social benefit is, among other things, the benefit of food security. For the western consumer, however, this is not a burning issue. In other countries where there are food shortages, food security may well be something which has great value in society. Food quality is something which western consumers are greatly concerned about. This could concern a good proportion of healthy or health-promoting substances or a low content of unhealthy substances. The production of high quality substances, such as medicines (pharma crops) or raw materials for energy production (biofuels) in GM crops, could also be seen as a social benefit. Where this makes a contribution to people's welfare, recreation can also be grouped under social benefit. Examples of this might include GM forests as recreation areas, opening agricultural businesses to visitors and for excursions, participation in events, sailing or walking tours alongside or through parts of a farm. These are some of the aspects that were mentioned in making organic farming more sustainable and which could also play a role in other agricultural systems.[46]

4.1.2 ECONOMIC BENEFIT TO SOCIETY

Economic benefit relates mainly to an agronomic benefit; greater yield per hectare and harvest security. The GM crops currently on the market are designed to have properties which will contribute to this: insect resistance and herbicide tolerance. The economic sustainability of a crop could also relate to other properties, such as a more efficient metabolism or faster growth. The production of high quality proteins in plants could result in increased production, cost savings or a reduction in waste in comparison with a chemical synthesis or through bacteria production. An increase

in yield/profit and the production of high grade substances like biofuels, could also constitute an economic benefit and thus help to benefit society.

4.1.3 ENVIRONMENTAL BENEFIT TO SOCIETY

The legislation in force on GM crops is mainly intended to prevent an adverse impact (damage to the environment or harm to humans). A GM crop could also be ecologically beneficial to the environment and thus indirectly benefit the producer and consumers. An example in this context would be a GM crop that is suitable for phytoremediation or soil remediation. Furthermore, GM crops may be able to help to make the nature of the chain more sustainable. A lot of the fruit and vegetables in Dutch supermarkets comes from other (warmer) countries, despite the fact that this produce could also be grown on Dutch soil. Owing to the climate in the Netherlands, these crops would be seasonal and therefore not economically attractive. If GM crops were to be adapted to grow in a colder, warmer, more damp or indeed drier climate, this could represent a cost saving in the area of transport. This would bring an economic benefit as well as an environmental one, because of the reduced CO_2 emissions.

4.1.4 RELEVANCE OF THE BENEFIT TO SOCIETY THEME IN RELATION TO CULTIVATION AND/OR IMPORT

The benefit to society theme is an important one in Europe because of the controversy surrounding GMOs among certain groups in society. They expect that the application of GM crops should have some added value in relation to the present conventional cultivation of crops. This added value could lie in a reduction in the environmental pollution caused by crop protection products, through the use of disease or insect resistant crops instead. Besides the desirability of more sustainable or less polluting farming methods, the benefit to society could also become more imperative. Due to climate change it is also possible that new pests could become established in European countries. An example of this is the corn borer which currently occurs in Southern Europe but is spreading to other parts of Europe. Benefit to society also plays a role in relation to cultivation outside Europe, but in a different way. Food and harvest security are more likely to be seen as a benefit to society in developing countries than in Europe.

4.2 ECONOMICS AND PROSPERITY

THEME 2: ECONOMICS AND PROSPERITY

Criterion 2: The production and use of GM crops contributes equally to local and general prosperity and, where possible, leads to an improvement.

Indicators: employment, incomes, cost cutting during production or use, yield/profit.

Prosperity is the degree to which needs can be met with the available resources. The GNP per capita is often used as a measure to indicate prosperity, because this is objectively measurable. However, the value of this is limited because, among other things, it fails to take into account the distribution of wealth or the presence of natural capital. The prosperity theme can therefore be combined with the welfare theme to create as broad a definition of the positive factors in people's lives as possible. Prosperity, however, can also have a downside which ultimately has an adverse impact on welfare. In striving for prosperity; the satisfaction of needs with the available resources, raw materials can become exhausted and the natural environment polluted or depleted. Therefore it is not just a matter of prosperity at the individual level, but also a sustainable economy at the collective level or as a society. A sustainable economy provides for the prosperity and welfare of the individual, for the present and future generations. This means that an economy is sustainable as long as it does no irreversible damage to the environment which then threatens the prosperity of future generations.

4.2.1 EMPLOYMENT

Individual needs essentially refers to the primary necessities of life, such as food, clothing and housing. Depending on the available resources, these can be provided for in different degrees. To be able to provide for one's needs it is, in any event, necessary to have an income, and employment is an important prerequisite for individual prosperity. Employment also has an influence on welfare. Without work and an income it is not possible to provide for one's own livelihood. This can have an adverse effect on welfare. The production of both conventional and GM crops can create employment opportunities and thus generate income for the local population. When the production of GM and other crops requires less maintenance or becomes less labour-intensive, labour can be released for other activities, such as logistics, but this also results in a decline in employment in agriculture.[47] The industrialization of agriculture in general, in which manpower is replaced by machinery, can also have this effect. The creation or preservation of employment in the cultivation, transport and processing of GM (or non-GM) crops can contribute to a more secure livelihood for the local population.

4.2.2 SUSTAINABLE ECONOMY: EFFICIENCY AND PRODUCTIVITY

Economic performance can be measured in terms of efficiency, productivity, capital and the cost of labour. Economic sustainability in the production of a GM crop can be expressed in terms of cost-savings and/or less environmentally polluting aspects (such as a reduction in the use of crop protection products, or irrigation) but also in terms of a higher yield per hectare (ha.) and the final profit of a business or farm. The creation of employment during production and processing contributes to local and general prosperity and thus ultimately

to economic sustainability. However, this process must be feasible now and in the future. This means that a balance has to be found between the cost (in relation to the use of agricultural land) and the return (yield, income and profit). Moreover, the profit and income of an agricultural business can only be generated provided that people can and want to buy what has been produced there. There has to be a demand for it. Transparency with regard to the production process is thus also an aspect of economic sustainability. In Europe, in particular, where consumer freedom of choice plays a prominent role, this is an important consideration. Transparency, in the first place, serves to inform the consumer but can also help to increase public acceptance or remove possible fears.
Economic sustainability in the use of GM crops could mean that the processing or transport of a GM crop contributes to the local, national or international economy through the creation of employment opportunities. Furthermore the efficient processing of a GM (or non-GM crop) may be cost-effective and therefore economically sustainable. This also applies to limiting the amount of waste generated during processing and/or transport. This aspect is covered in detail in the Cramer criteria. For a further discussion of the welfare and economics theme the reader is referred to the Cramer criteria and the Netherlands Technical Agreement 8080-2009.[13, 48]

4.2.3 RELEVANCE OF THE ECONOMICS AND PROSPERITY THEME TO CULTIVATION AND/OR IMPORT

The prosperity theme plays a role in cultivation elsewhere in the world followed by import into Europe, and in cultivation in Europe too. For countries outside Europe, developing countries in particular, this concerns the primary necessities of life which are less immediately to hand than they are in Western countries. In Europe, for example, this will concern employment in the plant breeding and agricultural sectors. Although the Netherlands is not dependent on local agriculture for its food supply, there are regions where employment (and the local economy) are supported mainly by certain crops, such as potato growing, greenhouse horticulture or bulb cultivation. Efficiency and productivity are important in a sustainable economy, as is a reduction in environmental pollution. It is not just prosperity but economics too, which are relevant to cultivation both in the European member states as well as elsewhere. A reduction in the use of crop protection products, less polluting methods of processing or a reduction in transport costs will all contribute to a more sustainable form of economic development and are equally relevant in Europe as in the rest of the world.

4.3 HEALTH AND WELFARE

THEME 3: HEALTH AND WELFARE

Criterion 3: The production and use of GM crops means that the health and welfare of workers, the local population and consumers remains at the same level and, where possible, improves.

Indicators: human rights, labour relations (participation, privacy, equal treatment, staff turnover, dismissal), employment conditions (safety, remuneration, working hours).

Welfare can be defined as a person's good mental and physical health. Welfare relates both to physical health in the sense of not being sick or disabled, as well as to mental health, in the sense of satisfaction and contentment. These components are influenced, among other things, by the conditions in which a person lives and works, but also the social or political climate in a country. Welfare may be entirely separate from prosperity, but is often linked to it. In the context of agriculture this welfare theme can be subdivided into a number of relevant associated themes which to a large extent determine the social conditions of the local population, i.e. human rights, ownership and usership rights and working conditions.
Under welfare, the Cramer criteria devotes separate attention to the integrity of businesses where the production, processing or transport of agricultural crops takes place, and preventing corruption. Changes in land use in the region, as well as food and land prices have an influence on the welfare of the local population. Monitoring the effects of business activities on the local population with the Social Performance Indicators of the GRI (Global Reporting Initiative), for example, may be a first step towards gaining more insight into these developments.[49] The themes of human rights and working conditions will be briefly discussed in the sections below.

4.3.1 HUMAN RIGHTS

The non-violation of human rights is a minimum requirement for the sustainable application of GM crops. This point is not specific to GMOs and applies to all agriculture. This is a matter of preventing things which violate human rights, such as discrimination, child labour, forced or coerced labour and the protection of aspects of freedom such as the freedom to form trade unions and the rights of indigenous peoples. Recognition of the ownership and usership rights of the local population, as well as respect for these rights (e.g. with regard to agricultural land) are also important here.

4.3.2 WORKING CONDITIONS

Working conditions, first and foremost, concern the safety of the workforce during the work, as well as working conditions in the sense of the number of hours worked and fair pay for the work carried out. The safety of the working conditions of the labourers involved in the cultivation of GM (or non-GM) crops is a minimum requirement here. The protection of personnel during work is safeguarded in the Netherlands under the health and safety (ARBO) legislation. In the international context the International Labour Organisation (ILO) is dedicated to securing proper and safe working conditions. Working conditions in farming could, for example, relate to the use of crop protection

products. In developing countries in particular, farmers and farm labourers often come into contact with crop protection products which constitute a health hazard, without proper personal protection. The use of less environmentally polluting and less hazardous crop protection products and a reduction in the number of treatments can have a positive effect on the health of farm workers. When admitting a GM crop, the environmental and health risks of crop protection products which a GM crop is resistant to or tolerant of could be looked at.
Various lists are maintained of permitted or, more specifically, banned crop protection products in terms of safety. In Europe rules are drawn up on this which are implemented in the Netherlands by the Board for the Authorisation of Plant Protection Products and Biocides (CTGB). At national and international level there are initiatives too, such as the Pesticide Action Network (PAN) and the Rotterdam Convention, which aim to reduce the use of extremely harmful crop protection products.[50,51] For a further discussion of the health and welfare theme the reader is referred to the Cramer criteria and the Netherlands Technical Agreement 8080-2009.[13,47]

4.3.3 RELEVANCE OF THE WELFARE THEME TO CULTIVATION AND/OR IMPORT

The theme of welfare mainly applies to cultivation outside Europe. The reason for this is that welfare in terms of human rights and working conditions, is already largely laid down in legislation and regulations and is not (or no longer) an issue in the Netherlands and other European member states. In countries outside Europe minimum standards with regard to working conditions and worker rights are not always provided. Therefore this theme will play a greater role in cultivation elsewhere in the world, followed by import into Europe.

4.4 LOCAL AND GENERAL FOOD SUPPLY

THEME 4: LOCAL AND GENERAL FOOD SUPPLY

Criterion 4: The production and use of GM crops means that the local and general food supply remains at the same level and, where possible, improves.

Indicators: food security, fair trade.

The production of GM (or non-GM) crops in areas where previously there was no agricultural system or a different one, can have a major impact on the lives of the local population and the local ecosystem. This impact may be adverse, but could also bring benefits in terms of the local and general food supply.
The introduction of GM (or non-GM) crops can lead to a change in the local food supply or loss of local agricultural applications, such as the production of building materials. Deforestation and clearing of an area with the aim of taking it into use as agri-

cultural land may be the result of the introduction of a different farming system. The loss of local applications or other effects of changes in land use further to the introduction of new agricultural crops, is also referred to as a displacement effect (Cramer criteria) or shifting effect (Bio-Raad). The Bio-Raad states that a shifting mechanism can work in various ways, for example, in time (towards later generations), distance (towards different regions) or from one theme to another. This also includes effects due to changes in land use, such as a rise in local land and/or food prices. The impact on the environment of a change in land use will be discussed under themes 8 and 9 in this report.

A change in land use can have a positive impact on the local population or the environment. Many countries are not self-sufficient. They are dependent on the import of food from other countries. Import and export make it possible to distribute food and create or maintain employment elsewhere, together with a more secure livelihood for the local population. Where GM (or non-GM) crops are intended for export, the use of local goods and services, support for projects which contribute to improving the local infrastructure and entering into financial commitments with the local population, can contribute to the local economy.[18]

The cultivation of GM crops is furthermore not exclusively related to farming for world markets, but could also make a contribution to the local food supply. In areas where the cultivation of GM crops is intended (or also intended) for the local food supply (or more general food supply), greater harvest security because of the built-in properties of GM crops can lead to more stable food production and food prices.[52] When crops can be grown closer to home on soil which was previously not suitable for the type of crop, or had become unusable because of drought or excess water, this also brings a benefit for the local population.

4.4.1 RELEVANCE OF THE FOOD SUPPLY THEME TO CULTIVATION AND/OR IMPORT

In the Netherlands, and other European member states, there is generally little connection between the local production of food and the food supply, not least, because of the huge import and export flows. Many European member states are not dependent on the local agriculture but, in fact, the import of products. Europe has its Common Agricultural Policy (CAP) for local food production. The aim of the CAP is to ensure that farmers can enjoy a certain standard of living, consumers have good quality food for a reasonable price and conservation of the agrarian heritage at the same time.[53]

The theme of local food supply is less relevant to cultivation within Europe. The theme and its associated criterion on local food supply, however, is highly relevant to countries outside Europe, and developing countries in particular, where subsistence farmers grow food for their own families or the local community and they lack the financial means to obtain this food elsewhere.

4.5 CULTURAL HERITAGE

THEME 5: CULTURAL HERITAGE

Criterion 5: The production of GM crops offers room, if so desired, for the conservation and continuation of specific cultural heritage aspects or other local applications (such as building materials, medicines).

Indicators: local applications and/or traditions, autonomy of local population.

Culture in the context of farming and the ecosystem relates to the way in which people experience their humanity in relation to their non-human environment, with animals, with 'nature' and how they see human intervention in that context. The dynamic concept of 'what is natural' is often used to describe how people perceive the relationship between humans and the non-human environment. This relationship is characterized by the way in which humanity has already influenced the natural environment for centuries, through animal and plant breeding and the building of infrastructure. Cultural heritage or domesticated nature is more often what this refers to. The appreciation of tradition, landscape, and the views people hold about nature and the various farming systems, all come under the heading of 'cultural heritage and what is natural'. In our society, and in others too, there are wide ranging views about what is natural and what should be considered (and conserved) as cultural heritage. What is key here is whether the view held about cultural heritage and what is natural is static or more dynamic and the degree to which human intervention in the natural environment is accepted.[18]

Under the theme of local and general food supply it is stated that the production of GM crops in areas where there was previously no agronomic system, or a different one was in operation, this may have a major impact on the lives of the local population and the local ecosystem. It is further stated that the loss of local applications does not necessarily have to have an adverse impact on the local population but may actually contribute to a higher level of production or better food security.

There are, however, also circumstances where it would be desirable to maintain the existing agricultural system or local applications, even where these may not be the most efficient or productive. The reasons for this may be because they form part of a particular landscape or belong to a certain culture or tradition which people wish to preserve. The recognition of formal and traditional rights of local populations with regard to land and resources, and respect for these rights, could be a contributing factor in allowing GMOs to be cultivated on their own land. It may also be the case, however, that people do not wish to maintain these traditions. In the case of import it is then a question of whether another country should be forced to maintain a less efficient or obsolete system because outsiders see this as part of a cultural heritage. This may be a reason why it would perhaps not be desirable to apply this criterion as an argument with regard to import from another country.

4.5.1 RELEVANCE OF THE CULTURAL HERITAGE THEME TO CULTIVATION AND/OR IMPORT

The theme and criterion of cultural heritage is relevant to cultivation both in Europe and elsewhere. In European member states the cultivation of local and traditional produce may have a certain cultural heritage value which people wish to preserve. This could include products which derive their flavour from a specific location and tradition or a traditional method of preparation. The protection of cultural heritage is not specific to GM crops or GMOs. In Europe certain products and product names have already been protected for a long time, such as Parma ham in Italy and, feta cheese from Greece.[54] The cultural heritage theme is also relevant to countries outside Europe with different cultural backgrounds and values which are considered to be important.

4.6 FREEDOM OF CHOICE FOR CONSUMERS AND MANUFACTURERS

THEME 6: FREEDOM OF CHOICE

Criterion 6: Consumers and manufacturers' freedom of choice regarding GMO (or GMO-free) is safeguarded in the production and import of GM crops.

Indicators: labelling of GM (and GM-free) products, information provided on products, directives/ legislation on co-existence, innovation and research freedom.

Freedom of choice is being able to make an informed choice and is part of autonomy, or the right to self-determination. The freedom to decide for oneself is an important element in the social component of sustainability and was even one of the basic principles in the European Directives and legislation on GMOs: freedom to deliberately choose whether or not to have GMOs.[55]

That freedom of choice, however, is not exclusively linked to genetic modification. The individual's freedom of choice is considered to be of great importance in Europe in many different areas, whether it be the freedom to choose between more or less healthy products, between organic and conventional agricultural produce or products containing GM elements.

Freedom also plays a role in products which may or may not have been tested on animals. In an assessment framework on the sustainability of GM crops, alongside freedom of choice with regard to GM or GM-free, sustainable or non-sustainable could also be applied as a criterion. Operationalization of consumer freedom of choice in relation to GM crops can be achieved through the labelling of GM (or GM-free) products. Manufacturers' freedom of choice is related more to the co-existence of GM crops and conventional or organic crops. These topics will be discussed in the following two sections.

4.6.1 CONSUMER FREEDOM OF CHOICE: LABELLING

The importance of consumer freedom of choice rests on two things. First, the availability of freedom of choice. In the case of GM crops this will primarily be about the choice of products which either do or do not contain GMOs. In Europe the choice of GMO or GMO-free is facilitated through mandatory labelling. Because some European citizens are fundamentally opposed to genetic modification, it is mandatory in Europe to label GMOs and products containing GMO elements.[56] Because this sometimes involves extremely small, hardly measurable quantities, in Europe threshold values have been set above which a product must be labelled. European Regulation (EC) no. 1830/2003 covers the traceability and labelling of genetically modified organisms and the traceability of food and animal feed produced with GMOs. EC Regulation 1829/2003 covers genetically modified foods and animal feed.

Owing to the objection to GMOs among certain groups in society, the introduction of mandatory labelling has meant that the number of products in Dutch supermarkets containing GM elements has also remained extremely small. It is questionable whether public acceptance of GMOs will ever increase when consumers cannot choose these products. Because freedom of choice naturally means that people must also be offered the freedom to choose GM products. The GM crops currently on the market are mainly those which provide the producer with an agronomic benefit. In the future, however, it is expected that GM products will also come onto the market which offer consumers a benefit, such as an increased level of health-promoting substances, like Omega-3 oils or vitamins. There is much speculation on the matter of whether these new GM products will persuade consumers. On the one hand, research on consumer choice indicates that they will buy GM products if they are available in a shop and offer a benefit.[57] While another study, on the other hand, concludes that there are no indications that GM products will gain more public acceptance in the short term.[58]

The second aspect involved in freedom of choice, is the available information on the various options, on the basis of which a considered choice can be made. In Europe products containing GMOs, or GMO elements, must be labelled as such and state which ingredients come from GMOs. For consumers with a fundamental objection to GMOs this information is most probably sufficient to be able to make a choice. Other consumers with a *'no, unless'* or a *'yes, but*' attitude with regard to GMOs may well need more information on which to base their choice.

This report is concerned with the conditions or criteria for the social, economic and environmentally sustainable application of GMOs. It is worth considering whether a sustainability label is an option that might also be offered to consumers. What choice will a consumer make when a product with a GMO label also has a label showing a positive score in terms of sustainability in comparison with a conventional product? Aspects such as health impact on workers, employment and working conditions are not generally visible in the imported, processed or natural end product, unless a form of labelling is used which certifies these aspects. An example of this is the Fair Trade label in which the focus is on fair payment of the producer.

Operationalization of freedom of choice in the form of mandatory labelling would appear to be anything but simple in practice.[59] The European labelling of GMOs would lead to a discussion among consumer organisations who are critical about GMOs, as well as animal feed manufacturers and the parties involved in the logistics chain.[60,61,62] The reasons for this are that mixing of products with different origins in the production chain, due to the increasing area of land under cultivation with GM crops, is becoming more and more difficult to prevent and that, to date, none of the GMO-exporting countries has the same labelling standards.[63] Furthermore, it is not always possible to distinguish GMOs in the end product from the conventional crop. Soybean oil no longer has any DNA in it and GM-soybean oil is therefore chemically indistinguishable from conventional soybean oil. Because the oil comes from GM soybeans, in Europe it is mandatory that this oil is labelled as such. To the displeasure of soybean farmers in South American countries where this is not required. In recent years there have been initiatives in Europe which even go a step further. A number of dairy producers in European countries have taken the step of specifically stating on their milk and dairy produce when the cows from which the milk came have been fed with GM-free cattle feed.[64] The development of new techniques in biotechnology which blur the boundaries between conventional breeding techniques and genetic modification, will only intensify the debate on the feasibility of labelling and guaranteed GMO-free products.[65]

4.6.2 FREEDOM OF CHOICE FOR MANUFACTURERS: CO-EXISTENCE AND FREEDOM TO INNOVATE

Freedom of choice is primarily associated with the consumer who wants to be able to make a conscious choice about certain products. The manufacturer (i.e. industry), however, must also have freedom of choice about whether or not to cultivate GM crops. In this report manufacturer refers to biotechnology and breeding organisations, as well as agribusinesses where agricultural production takes place.

Co-existence

Through cross-breeding and outcrossing the cultivation of GM crops could lead to the contamination of conventional or organic crops. Given the large area of land under cultivation with GM crops worldwide this is something which will become increasingly difficult to prevent.[41] Cross-fertilization of GM and conventional crops can occur in the field due to pollen exchange. Mixing can also occur during harvest, storage and transport. When this mixing leads to a GMO percentage greater than 0.9% in products, this can cause economic damage to the breeders involved and the processing industry, because their sales markets would be restricted. Mixed sowing seed can become a problem when farmers breed from it again with seed that they have harvested themselves from their own farmland. In Europe many farmers buy their sowing seed every

year from commercial companies. Nevertheless, in practice, cross-fertilization cannot be ruled out with complete certainty. To prevent the various parties holding each other liable it is necessary to make agreements about the measures and separation criteria to be applied. Although some are sceptical about the feasibility of effective co-existence, experts predict that for first generation GM crops, co-existence will be possible, in any event, for the next 15 years.[58] In the past agreements have been made in the Netherlands, and in other European countries too, between the various actors in the field. These agreements are intended to ensure the harmonious co-existence of GM cultivation alongside conventional and organic farming.

CO-EXISTENCE IN THE NETHERLANDS

In the Netherlands it has been attempted to provide regulations by drawing up a 'Covenant on Co-existence in the Primary Sector'. This agreement led to the 'Crop Co-existence 2005' regulations of the Agriculture Commodity Board (Hoofdproductschap Akkerbouw, HPA).[66] There was, however, some resistance to these regulations. Platform Biologica, the lobby group for organic farmers, withdrew from the covenant in the summer of 2007. They held the view that there should first be clarity about the provision of a compensation fund. What should the extent of the compensation fund be and who would furnish it? On 6 November 2007 the Lower House of Parliament adopted a motion which advocated that a compensation fund be set up whereby the cost of 'unintentional' contamination by GM crops could be claimed from those causing it.

In September 2008 Minister Gerda Verburg of Agriculture, Nature and Food Quality, announced that agreement had been reached on a residual damage fund.[67] The parties involved, the Ministry of Agriculture, Nature and Food Quality (LNV), LTO, Biologica and Plantum NL, reached agreement on the setting up and funding of a residual damage fund for maize, potato and sugar beet. This damage fund will be funded by the suppliers of basic agricultural materials to compensate farmers and horticulturists for the damage caused by cross-breeding with GM crops for which no one can be held liable. In the event of economic damage at a farm where someone can be held liable, the damages will be claimed from this individual under the Civil Code. This agreement covers only damage due to cross-fertilization on the farm itself. A separate process will be started for 'damage further along the chain'. No agreement has yet been reached on the provision and cost of targeted monitoring of the harvest on farms which are deemed to be 'at risk'. The regulation can only take effect once agreement has been reached on all points.

Innovation and research freedom

Rules and agreements on co-existence have mainly arisen at the initiative of GMO-free producers who want to prevent that conventional or organic crops become crossed with GM varieties. This mainly touches upon the freedom of choice of the non-GM grower. The producer of GM crops, however, must also have freedom of

choice. When these growers cannot openly decide to cultivate or do research on the possibilities offered by GMOs, then there cannot be said to be freedom to innovate or undertake research, or any real freedom of choice. In practice, this freedom of choice can be jeopardized due to the destruction of field trials, and protests and demonstrations by opponents of GMOs.[68,69,70] The freedom of choice to innovate can also be threatened by developments in the commercial sector. In the area of plant seeds, the power of a few multinationals has been concentrated by a series of mergers at the start of this century. A small group of multinationals represents a considerable proportion of the world's agricultural seed and seed potato market. Figures on the share held by the top three multinationals in 2006 range between 30% and 40% of the world market.[71,72,73]

Small and medium-sized enterprises (SMEs) could be blocked from pursuing innovation by multinationals taking out patents on specific genes or plants. These large corporations are generally more able to bear the administrative burden of the successful market introduction of a GM crop. This burden (i.e. costs) are then earned back by obtaining patent rights extending over many years.

Patents can have an adverse impact too specifically on smaller plant breeding organisations which have an interest in breeding rights that permit the use of others' seeds in order to obtain new crop properties through breeding. When agricultural or plant breeding companies have less choice in the basic materials that they can purchase to work with or produce, their freedom of choice is restricted. The commercial success of a GM variety could also lead to a stagnation in the innovation process for conventional varieties. The share of GM soy has increased in recent years to more than two thirds of the worldwide production.[24] In the biggest soy-producing countries, like the United States or Argentina, the share of GM soy in the total national soy production is now more than 90%[74]. Because GM soy is most common is these countries, the supply of conventional soy seed will very likely further decline and become less attractive to plant breeding companies. Opposition to the monopolies of large multinationals also arises from the fear that meeting the primary need for food will become dependent on just a few companies. Furthermore, the EU and various other countries have competition legislation which is intended to prevent the formation of monopolies and abuse of a position of economic power.[75] Such legislation may possibly be able to counter some of these objections.

4.6.3 RELEVANCE OF THE FREEDOM OF CHOICE THEME TO CULTIVATION AND IMPORT

Freedom of choice for the consumer in Europe is laid down in the legislation and operationalized by means of a labelling requirement for GMOs and products containing GMO elements. This criterion is therefore less relevant to cultivation in Europe. As with safety, freedom of choice and the provision of information on products is less of a standard practice in other countries. The freedom of choice criterion for the consumer

is therefore more relevant in relation to cultivation elsewhere in the world, followed by import into Europe. In the Netherlands agreements have been made that are laid down in the co-existence covenant to safeguard the producer's freedom of choice. The freedom of choice of producers is not laid down in this way in all European member states. Freedom of choice for the producer is an important criterion for cultivation in the various member states of Europe, as well as cultivation elsewhere in the world.

4.7 THE SAFETY PRINCIPLE

THEME 7: SAFETY

Criterion 7: The admittance and assessment of GM crops in terms of safety to humans and the environment takes place in the country concerned in accordance with the legislation on the basis of the international agreements in force concerning human and environmental safety.

Indicators: food safety and environmental safety (and the legislation to assess this).

The GM crop developed and the products created from it must be safe to humans, animals and the environment. The theme of safety differs in this respect from most other themes and criteria covered in this report. Safety will be assessed on the basis of the product, the GMO itself, while most other sustainability criteria relate to the way in which the GMO is applied and used.

4.7.1 HUMAN AND ANIMAL SAFETY

Human and animal safety in this context refers mainly to food safety. The GM crop or products which include GM crops may not have any toxic, allergenic or other adverse effects further to consumption by human or animal. In Europe the food safety aspects in cultivation and/or import are assessed by the European Agency for Food Safety, the EFSA.[76] The individual member states also test food safety. In the Netherlands this assessment is carried out by the GMO Bureau (bureau Genetisch Gemodificeerde Organismen (bGGO)[77] and the Institute of Food Safety (Instituut voor Voedselveiligheid (RIKILT)).[78]

4.7.2 ENVIRONMENTAL SAFETY

There is a wide range of ecological indicators to test the safety of GM crops in relation to the environment. GM crops may not have any adverse, uncontrollable or irreversible effects on existing ecosystems. In an assessment of GM crops the spread of the introduced genes to other species, selective advantage in relation to existing related organisms and adverse effects on non-target organisms, among other things, would be looked at. In the Netherlands this assessment would be done by COGEM.

4.7.3 RELEVANCE OF THE SAFETY THEME TO CULTIVATION AND/OR IMPORT

In Europe separate directives and regulations have been drawn up on the application of GMOs, to safeguard the safety of humans, animals and the environment. Safety is a requirement for the admittance of GMOs for both import and cultivation and is laid down in European directives and the national legislation of European member states.[79] These directives and regulations have been implemented in Dutch legislation in the Environmental Management Act (WM), Genetically Modified Organisms Decree (Environmentally Hazardous Substances Act) (Besluit GGO), and the Genetically Modified Organisms Regulation (Regeling GGO). This legislation states that the safety of the GMO to humans and the environment must be tested and that any risks must be limited.

COGEM has also been asked, however, to look at the cross-border situation and take into account the production of GM crops in other countries, followed by import into Europe. Outside Europe comprehensive legislation and regulations on the application of GMOs cannot be presumed to exist in all countries. GM crops are grown in more and more countries worldwide. A number of countries already have comprehensive legislation on the application of GMOs. In other countries the drafting and implementation of legislation and guidelines is in development (see also the Asia Pacific Consortium on Agricultural Biotechnology).[80] In this process, countries which have already developed and implemented legislation on GMOs are often looked to, such as Europe and the United States.

The implementation and operationalization of a legislative framework to safeguard the application of GMOs is an important criterion for the sustainable use of GM crops. This criterion is not relevant to cultivation in Europe, as comprehensive legislation on this is already in place. This criterion is relevant, however, where cultivation takes place elsewhere in the world followed by import into Europe, because it cannot always be assumed that such a regulatory framework is in place. In other words: the safety of GM crops must be a criterion, not only in the Netherlands or Europe, but also beyond, anywhere that GM crops are cultivated which are then offered for import into Europe.

To safeguard safety in the national and international transfer, handling and use of GMOs, the Cartagena protocol came into force in 2003.[81] To date, 103 countries have signed the protocol and 90 have ratified it. COGEM notes that a number of the biggest GMO-producing countries have not signed the protocol (e.g. the United States) or have signed but not ratified (e.g. Argentina and Canada).[82] The most well known standard in relation to food safety is the Codex Alimentarius.

CARTAGENA PROTOCOL (BIOSAFETY PROTOCOL)

The Cartagena Protocol on Biosafety, also known as the Biosafety Protocol (BSP), is a supplementary agreement to the UN Convention on Biological Diversity. The protocol entered into force on 11 September 2003. Its objective is to contribute to protecting safety in the transfer,

handling and use of GMOs which could endanger the conservation and sustainable use of biological diversity. It mainly provides for rules on the transboundary movement of GMOs.
The protocol prescribes that in the event of transboundary movement of living GMOs which are intended to be introduced into the environment (e.g. for field trials) the exporter must inform the importing country in advance about the proposed transfer and must await permission from the country of import (known as the 'advanced informed agreement' or AIA procedure). On the basis of its own risk assessment the receiving country can refuse the GMO transport. For the transboundary movement of GMOs which are intended to be used as food or animal feed, or for direct processing in products, the protocol establishes a Biosafety Clearing House (BCH) for parties to exchange information.[83] Risk assessments carried out in different countries are also available here.
The Cartagena protocol provides a description of the way in which the risk assessment should be carried out. The protocol also addresses other aspects, such as socio-economic considerations, rules on liability and compensation in the event of damage, and rules for cases where the protocol is not observed.

CODEX ALIMENTARIUS
The Codex Alimentarius (World Food Code) is a collection of standards on food, food production and food safety. The main goals of the Codex Alimentarius are the protection of consumer health, ensuring fair trade practices in food trading and promoting the harmonization of all food standards drawn up by international organisations. In addition to standards on specific foods, the Codex Alimentarius contains general standards covering matters such as food labelling, food hygiene, food additives, pesticide residues, and procedures for assessing the safety of processed foods. It also contains guidelines for official import and export inspection and certification systems for foods.
The Codex Alimentarius is recognized by the World Trade Organisation as the international authority on the subject of food safety and consumer protection.[84]

4.8 BIODIVERSITY

Agriculture has always had a decisive impact on the ecosystem in which these activities take place. What is important in sustainable development, however, is that the balance in an ecosystem is not irreparably damaged or disrupted. Biodiversity is important to the stability or robustness of an ecosystem and therefore a recurring element in almost all existing sustainability criteria.
Biodiversity may be defined as the variety of living organisms functioning in ecological systems.[13] A fuller definition can be found in the fourth National Environmental Policy Plan (NMP4) of the Ministry of Housing, Spatial Planning and the Environment (VROM). Here biodiversity is described as the driver of processes and conditions in natural ecosystems which support the welfare and prosperity of humankind:

'Biodiversity provides the goods, raw materials and services which we need to be able to eat and drink, and to live and work. One of its essential functions is to regulate the basic processes which make life on earth possible: the production of clean air and biomass, the preservation of food, nitrogen and water cycles and the climate system (the regulatory function). Besides this, biodiversity has an economic function, seen directly in farming, forestry management, fisheries and biotechnology and more indirectly in pharmacy, the chemical industry and tourism (the production function). Species diversity also influences the quality of life, through our enjoyment of the flora and fauna (the information function). Thus, biodiversity is a life insurance for present and future generations'.[16]

Climate and seasonal changes have an impact on biodiversity, as do changes in land use. Biodiversity is therefore not a fixed concept, but changes from one ecosystem to another. When the land use in a particular area changes because of agriculture, housing, industry or recreation, the biodiversity will also change: sometimes temporarily, sometimes permanently. When drawing up sustainability criteria it is therefore important to make a distinction between the biodiversity within an agricultural system and that outside of it. The biodiversity of land in its natural state will, of course, change as soon as farming starts to take place there. When the production of GM (or non-GM) crops is not permitted to cause any change in the biodiversity, what this means in effect is that no farming can take place in areas which have never been used for cultivation.

4.8.1 BIODIVERSITY IN CULTIVATED AREAS

THEME 8: BIODIVERSITY

Criterion 8a: The production of GM crops does not lead to a reduction in the agrobiodiversity of the agricultural ecosystem and where possible strengthens it.

Indicators: agrobiodiversity.

The biodiversity will always change relative to the original vegetation in areas where farming takes place. This biodiversity will be different than that of the original vegetation, where there was no soil tillage and no artificial regulation of water and nutrients. The biodiversity in an agricultural ecosystem is sometimes referred to as the agrobiodiversity. The minister's policy letter on agricultural biodiversity describes agrobiodiversity as the entirety of plant and animal genetic sources, soil and micro-organisms, insects and other flora and fauna in agro-ecosystems, as well as elements of natural habitats which are relevant to agrarian production systems.[85] The policy letter makes a distinction between three interconnected elements within agrobiodiversity: genetic sources, functional biodiversity and supporting biodiversity. Genetic sources refers to the hereditary material of plants, animals and micro-organisms, with an existing or potential value to humans. Functional biodiversity is formed by the

organisms and processes which, as a part of biodiversity, work to support the agricultural production process and thus provide ecosystem services.[86] Finally, there is the supporting biodiversity; the organic and natural landscape elements which exist because of the farming practices. These are organisms which have a direct relationship with the agricultural production and form part of the agro-ecosystem, such as meadow birds and the life found in a farm ditch.

Besides the type of crop that is cultivated, the impact of agriculture on biodiversity is influenced by uniform or varied land use patterns and the intensity of the production methods used. In general the impact will be greater with monocultures, or when the same crop is grown for years on end.[26] The genetic diversity of the crop itself is also part of the biodiversity. A narrow genetic diversity in an agricultural strain can play a part in the emergence of pests and the breakdown of resistance (possibly sooner).

To summarize: the production of GM crops in existing agricultural areas must not lead to a reduction in the agrobiodiversity in relation to conventional agriculture. Changes in biodiversity are already part of the present safety assessment of GM crops. Here a distinction is made between intended (accepted) and unintended effects. An insect-resistant GM crop may, of course, have an impact on the pest concerned (intended effect) but not a lasting unwanted effect on other organisms in the field (non-target organisms, NTOs). This also applies to soil micro-organisms. When a permit application is submitted for the cultivation of a GM crop, data must be provided which shows that there are no significant unwanted effects on NTOs in comparison with conventional cultivation.

4.8.2 BIODIVERSITY IN UNCULTIVATED AREAS

THEME 8: BIODIVERSITY

Criterion 8b: The production of GM crops does not lead to damage to protected or vulnerable biodiversity (including the places of origin of agricultural crops).

Indicators: protected and vulnerable biodiversity, places of origin of crops.

The protection of biodiversity does not mean that there may not be any farming in uncultivated areas or that existing agricultural areas should be returned to a natural state. There must be sufficient room left over to maintain the wealth of plant and animal species. With the growing world population, there is a growing demand for food, housing and prosperity. These developments mean that land is increasingly being cleared and cultivated. At the same time people are also becoming more aware of the importance of biodiversity and nature conservation. The protection of unique biodiversity and areas of natural beauty, alongside cultivated and urban areas, is seen in many cultures as a general benefit or value. Vulnerable and unique biodiversity, such as primeval forests, tropical forests and threatened animal species, as well as the places where cultivated crops originated, should be protected.

CENTER OF ORIGIN OF CULTIVATED CROPS

Every cultivated crop has its own center of origin, also known as its gene centre. This is the area from which cultivated crops originally came. In most cases the original species differs greatly from the cultivated crop as the consumer knows it. The potato *(Solanum tuberosum)* originally came from the Andes in South America. Maize *(Zea mays ssp. mays)* belongs to the grasses and originated in central America (Mexico), rice *(Oryza sativa)* is also a member of the grass family and was first grown in South East Asia (specific origin Korea) and Egypt. Europe was the center of origin for a number of crops too, such as some grasses and cabbage species *(Brassicaecea)*.

Over the years these crops have been 'cultivated' and, through breeding, adapted to the climate and the wishes of the consumer and the grower. In many cases the wild varieties of original species can be crossed with the cultivated species, and do still occur in their centers of origin. Some related wild species may have interesting genetic properties which can be introduced using classical and modern breeding techniques.

An example of this is the potato *(Solanum tuberosum)* which originally came from the Andes in South America and belongs to the nightshade family. In the 16th century the potato was introduced into Europe by the Spanish and turned out to be able to grow in almost any soil type in areas with a mild climate. It took many years for the potato to become an accepted part of the European diet. The reasons for this were that, among other things, the potato was considered to be poisonous (except for the tubers, the potato plant is, indeed, not edible and even poisonous). Through breeding the cultivated potato has acquired a better taste and shape. The cultivated potato, however, has also become less resistant to Phytophtora infestans, or potato blight. This fungus causes enormous damage to the potato crop. It was discovered that some wild potato plants are more resistant to this disease than our cultivated potato. In response to this scientists, breeders and plant growers have developed techniques to transfer the resistance genes from the wild potato species into the cultivated potato. The wealth of genetic information that is potentially available is one of the reasons for protecting the centers of origin of cultivated crops.

With a growing world population it is not a matter of whether the land used for agriculture has to be increased, but how this inevitable growth in the amount of land used for agriculture can be achieved in a way which is more sustainable. GM crops which help to increase the yield per hectare could help to limit the extent of the amount of additional land required for this purpose.

In areas where there is currently no farming, it should be investigated whether this is a vulnerable area, or one with unique natural features, or a place of origin for cultivated crops. The protection of these areas can be used as an argument not to introduce GM (or non-GM) farming in this environment. This point is not specific to GM crops but should generally be taken into account when deciding whether or not to introduce agriculture in uncultivated areas. If, in the future, GM crops are brought onto the market with new properties, such as stress-tolerance to salt, water or drought, this criterion could more specifically apply to GM crops. These crops are being developed with a

view to cultivation in areas which, until now, have not been suitable (or are no longer suitable) for agriculture. It will then also be determined whether these areas should be considered as unique natural heritage which is worth protecting.
When it is decided to start farming in an uncultivated area, the existing biodiversity can be taken into account in the development of this area by varying the land use while retaining part of the original vegetation. It states in the Cramer criteria that a minimum of 10% of the original vegetation should be conserved on the acreage of a production unit. The protection of vulnerable areas is not only the task of the local population and the authorities, but also of other countries which have trade relations with exporting countries. The protection of nature and the environment is a priority which is generally only observed once other, more pressing, needs of a growing population have been met, such as food and income (secure livelihood). Therefore where GM crops are cultivated for export, developing countries should be supported in doing this in a responsible manner. Education and a fair price for the products and services provided can contribute to this.
Various initiatives and global agreements have been made on the protection of vulnerable areas of natural beauty, such as the *Convention on Biological Diversity*.[87] Following three years of negotiation, the biodiversity convention was signed in 1992 at the opening of the Earth Summit in Rio de Janeiro and thereafter came into force on 29 December 1993. There are now 180 signatories to this UN convention, including the Netherlands and the European Union. The aim of the treaty is to conserve biological diversity, the sustainable use of its components and the fair and equitable distribution of the benefits arising from the use of biodiversity. The value of biodiversity is seen here not only from the human perspective, but also on the basis of nature's own intrinsic value.

Under the *Convention on Biological Diversity* the parties are required to develop national strategies as a framework for dedicated activities. To conserve nature and biodiversity in Europe, the European Union has taken the step of adopting *Natura 2000*. This is a coherent network of protected areas of natural beauty in the EU. In the Netherlands there are 162 such areas in total.[88] The Dutch government's strategy on biological diversity is derived from its policy plans on nature conservation, spatial planning, the environment, water and development cooperation and the Strategic Plan of Action on Biodiversity (SPA). Furthermore, at global level there are various lists and networks which identify such areas, such as the High Conservation Value network (HCV), UNESCO World Heritage Sites, and the IUCN List of Protected Areas. For a further discussion of the biodiversity theme the reader is referred to the Cramer criteria and the Netherlands Technical Agreement 8080-2009.

4.8.3 RELEVANCE OF THE BIODIVERSITY THEME IN RELATION TO CULTIVATION AND/OR IMPORT

This theme plays an important role in cultivation both in Europe and elsewhere. Each country is responsible for protecting its own biodiversity. A reduction in biodiversity

is also a global issue. In Europe biodiversity is included in Directive 2001/18 in the risk assessment for the admittance of GM crops. Besides looking at whether there are unintended adverse effects on non-target organisms, it also states in 2001/18 Annex II D2 that *'possible immediate and/or delayed, direct and indirect environmental impacts of the specific cultivation, management and harvesting techniques used for the Genetically Modified Higher Plants (GMHPs) where these are different from those used for non-GMHPs'* should be included in the risk assessment. An indirect environmental impact can also consist of or lead to a reduction in biodiversity.

4.9 ENVIRONMENTAL QUALITY

THEME 9: ENVIRONMENTAL QUALITY

Criterion 9a: The production and processing of GM crops means that the quality of the soil, surface and groundwater, and air does not deteriorate and where possible improves.

Indicators: emissions of ammonia, crop protection products and greenhouse gases, nutrient balance, water consumption, soil fertility, plant health and disease resistance.

This aspect is extensively covered in the Cramer criteria and is also discussed in the COGEM report 'Prospects for GM crops in sustainable agriculture'. This section will briefly deal with a number of points. For a further discussion of the soil, water and air quality theme the reader is referred to the Cramer criteria and the Netherlands Technical Agreement 8080-2009.[48]

The production of agricultural crops can have an adverse impact on the environment. In Europe and many other countries rules have therefore been drawn up to limit these harmful effects as far as possible. The use of crop protection products and artificial or animal fertilizer can impact the quality of the soil, water and groundwater. Tilling the soil can lead to depletion and erosion. The clearing of areas with large above ground (vegetation) or underground (soil) carbon reservoirs can lead to the emission of greenhouse gases. The use of crop protection products, artificial fertilizer and the CO_2 emissions of agricultural machinery also result in emissions to the air. Altogether, these aspects can be described as the environmental impact. GM (and non-GM) crops which help to improve yields without increasing the environmental impact, contribute to more sustainable agriculture.[47] Crops which are more able to withstand pests and weeds can produce a higher yield and thus less farmland, less crop protection products and less fossil fuels are needed for the same level of production. When less environmentally-polluting crop protection products can be used, this can also help to reduce the environmental impact. Promoting agricultural practices which benefit the environment and reduce pollution during processing and harvest, also contribute to more sustainable agriculture. In the following section a number of specific points will be discussed which play a role in soil, water and air quality.

4.9.1 SOIL

Soil quality in agriculture is the ability of healthy soil to provide sufficient nutrients, moisture and air for good crop production in the longer term with small losses to the environment.[89] This quality is determined, among other things, by the supply and drainage of water, the nutrient balance and the micro-organisms present in the soil. The use of land for agricultural purposes can disturb the balance of the soil or even cause damage to it in the form of erosion, depletion, pollution or increased salinity. This has to be taken into account during soil tillage in farming with GM, conventional or organic crops, by adopting a management strategy which is aimed at sustainable soil use. Farming practices which encourage reduced or minimum soil tillage can bring about a wider biodiversity of soil micro-organisms and thus also help to prevent erosion and reduce the emission of greenhouse gases.

4.9.2 WATER

Water quality (and quantity) is influenced by the additives used in agriculture, such as fertilizer and crop protection products. Part of these substances end up in the soil and are transported by drainage into the surface waters in the area or are discharged directly into the waterways due to drift when spraying. Incorrect land irrigation can lead to salination and erosion. Furthermore, the irrigation water used in the farming has to be extracted somewhere else. In sustainable agriculture the production and processing of GM (and non-GM) crops would not lead to a deterioration in the soil and surface water quality. Efficient water use and the careful use of crop protection products is therefore important.

4.9.3 AIR

With regard to agriculture, air quality may be influenced by the emission of ammonia when animal fertilizer is used, and also by the emission of crop protection products. Guidelines on the emission of these substances have been drawn up in Europe and in many other countries too.

4.9.4 GREENHOUSE GAS EMISSIONS ALONG THE ENTIRE CHAIN

THEME 9: ENVIRONMENTAL QUALITY

Criterion 9b: The production and processing of GM crops means that the emission of greenhouse gases along the entire chain (development, production, processing and transport) remains neutral or declines relative to conventional agriculture.

Indicators: balance in CO_2 emissions and uptake, efficient transport and processing.

This aspect is extensively covered in the Cramer criteria and is also discussed in the COGEM report 'Prospects for GM crops in sustainable. This theme will therefore not be considered at length here. For a further discussion of the greenhouse gases theme the reader is referred to the Cramer criteria and the Netherlands Technical Agreement 8080-2009.
During the production and transport of agricultural crops as well as processing, greenhouse gases (CO_2, methane, etc.) are stored and released each time. Due to the clearing and tilling of land, a lot of the stored greenhouse gases are released. Added to this are the greenhouse gases emitted by farm machinery (and later transport vehicles). In farming practices which encourage little or no tillage, more CO_2 remains stored in the soil. A method of calculating the greenhouse gas balance is in development for the criteria on the sustainable use of biomass.[90], This could also be used to measure greenhouse gas emissions during the production, processing and transport of GM crops.

4.9.5 RELEVANCE OF THE ENVIRONMENTAL QUALITY THEME TO CULTIVATION AND/OR IMPORT

The environmental quality theme is important to both cultivation in Europe and cultivation outside Europe followed by export to Europe. In many countries, environmental protection is already incorporated in national guidelines and legislation, under which harmful effects are already to some extent limited. Where such legislation has not yet been implemented, observance of the Stockholm Convention could be set as a minimum standard. In signing this convention a promise was made to phase out and no longer use the twelve pesticides most harmful to humans and the environment. Drawing up other specific standards which soil, water and air quality must meet is a task for national and local authorities, because these aspects are very much locally dependent. Because in Europe there are already various directives on controlling the emission of greenhouse gases and fertilizers, as well as preventing the leaching of crop protection products and biocides, this theme is less relevant to cultivation in Europe. However, not all countries outside Europe have such standards. This theme is therefore mainly relevant as a criterion for cultivation followed by import into Europe.

5

APPLICATION OF THE CRITERIA: CONSIDERATIONS REGARDING USE

Nine sustainability criteria have been identified and discussed in chapter four which could be used to determine what contribution GM crops can make to more sustainable agriculture. The next question is how these criteria can be applied in an assessment framework for GM crops. Although operationalization of the criteria was not part of the minister's request, some comments will be made in this chapter with regard to the selected criteria which may be useful when these are developed further at a later stage. A number of considerations and questions are set out in this chapter in relation to the specificity, frame of reference and measurability of the various criteria. Thereafter, consideration will be given to the applicability of the criteria to cultivation in Europe and cultivation elsewhere followed by import into Europe.

5.1 SPECIFICITY OF THE IDENTIFIED CRITERIA

In this report sustainability criteria have been drawn up for the application of GM crops. COGEM was asked, where possible, to formulate these criteria specifically for GMOs. In the introduction COGEM indicated that sustainability almost always relates to application and use. It was then concluded that many criteria for sustainable conventional or organic farming would also apply to the sustainable application of GM crops. Because these are the standards which these crops must meet in order to contribute to more sustainable agriculture. Apart from the themes of safety and freedom of choice, the criteria drawn up in this report are not specific to GMOs. The reason for this is not so much that GMOs are different in their application and use, but mainly because they are controversial in society and are therefore subject to additional rules.
Conventional agriculture was taken as the frame of reference in drawing up the criteria. The criteria are based on the principle that the application and use of GM crops should perform as well if not better than conventional crops with regard to the relevant theme. However, this does not address the question of whether conventional agriculture is sustainable. Different views are held on the matter of sustainability and what is sustainable development. The discussion on when a process or development is sustainable, is complex and will change over the course of time. Moreover, it is open to question whether there is any clear-cut answer to be given. When will agriculture

be considered sustainable (or sustainable enough)? It is not up to COGEM to provide an answer to this. COGEM has indicated that existing agriculture, depending on the farming system and cultivation method used, to some extent generally has an adverse but widely accepted impact on nature. In identifying the relevant themes for this report it was repeatedly stated at the LNV seminar, in the workshops, in meetings of the COGEM subcommittees and during the interviews with the experts consulted, that the draft criteria drawn up are not specific to GMOs and could be applied to agriculture in general. Others commented that it would therefore not be reasonable to apply these only to GMOs. It would be remarkable if a GMO crop were to be rejected on the basis of sustainability arguments, while these arguments apply to the same extent to conventional crops which are not subject to these criteria.

5.2 MEASURABILITY OF THE CRITERIA DRAWN UP

For the operationalization of the sustainability criteria it would be desirable that the indicators used to measure the criteria: a) are objectively measurable, and b) can be estimated in advance. The operationalization of the criteria did not form part of the minister's request. Therefore we have not gone into the measurability of the indicators mentioned with the criteria in this report.

As with the Cramer Criteria, not all the aspects mentioned can easily be measured; the cultural heritage and welfare themes, for example. For these aspects a reporting requirement could apply to begin with so that more information can be gathered. Based on this data a system can eventually be drawn up by which these aspects can be measured. A retrospective analysis of the application of existing GM (and non-GM) crops could provide more insight into the socio-economic impact of the cultivation and use of GM crops.

It is open to question whether the impact of the cultivation of a GM (or non-GM) crop on social, economic and environmental aspects, can always be predicted in advance. The interconnectedness of the essential elements of sustainability means that making such estimates is a complex matter and a number of assumptions almost always have to be made with regard to one or more of these elements. In estimating risks to health or the environment it is, to a certain extent, possible to make use of scientific studies and research. For new GM crops the impact on socio-economic aspects, such as welfare, employment or local food production, will probably be much more difficult to estimate or quantify. Furthermore, the impact of the cultivation of a particular crop will also depend on the region or area where this takes place. This cannot be determined in advance unless a permit is issued for a specific location. Application and the monitoring of application in practice may be the only way of being able to make a proper estimate of the socio-economic consequences.

To test the safety of GM crops, there is already a comprehensive risk assessment in place in which objectively measurable data are evaluated with regard to safety to humans and the environment. Measurable guidelines and rules with threshold values

have also been drawn up for the labelling of products containing GM ingredients. The results of these studies and measured values are still regularly the subject of discussion. This applies to various scientific studies which contradict one another, as well as to any one study which can be interpreted in different ways.[91] COGEM notes that when people already cannot agree on measurable facts, in practice the introduction of socio-economic criteria will be a complex task.

5.3 DISTINCTION BETWEEN CRITERIA FOR CULTIVATION AND IMPORT

In the letter requesting this report, it is stated that different aspects may well play a role in the cultivation of GM crops than in their import. In the development of the criteria in chapter four, it is each time briefly indicated whether the given theme is relevant to the discussion on cultivation in Europe, or to cultivation outside Europe followed by import. Table 5.1 provides an overview of the relevance of the theme and criterion to cultivation within the EU or import from outside the EU. A particular theme may be less relevant because there is already legislation or regulations on that specific topic, or because the theme is not (or no longer) a current topic of discussion.
There is another reason for making a distinction between cultivation and import. The operationalization of a sustainability assessment for cultivation in Europe will be less complex than the imposition of such requirements on countries outside the EU which export to Europe. The legislation may differ from one European country to another, but is essentially always based on European directives. The differences compared with countries outside Europe may be much greater. In view of trade relations, as well as politically and legally, it is much more complex to draw up an assessment framework for sustainability for import. Given the complexity of the various aspects involved in a sustainability assessment of GM crops in agriculture, experience could first be gained in Europe, for example, with the introduction of such an assessment framework for cultivation, making use of a small number of criteria, in which the assessment itself could be placed at as low an administrative level as possible.

5.3.1 THEMES RELEVANT TO CULTIVATION IN EUROPE

A number of the criteria drawn up relate to themes which are laid down centrally in European legislation, such as safety and freedom of choice. These would therefore appear to be less relevant because they are not new. Safety is the fundamental principle in the assessment of GM crops in Europe and will continue to be so. Freedom of choice too, is covered in the European legislation through a labelling requirement, among other things. Because these themes specifically constitute the basic underlying principles in the European legislation on GMOs, COGEM's view is that this should be stated. Biodiversity and environmental quality are also important to cultivation in Europe.

Biodiversity is partly laid down in the legislation on safety. There are also various initiatives on biodiversity, such as Natura 2000, to protect vulnerable biodiversity in EU member states. In the area of environmental quality, there are various directives which apply to agriculture in general. The themes of health and welfare, and local food supply are generally not topics of discussion in Europe (anymore) and thus less relevant to the current debate on the cultivation of GMOs in Europe. The themes and discussion points which are most relevant to the debate on GM crops in Europe which have not yet been centrally or nationally laid down in an assessment framework or regulated in any other way, are as follows:

- Benefit to society
- Economics and prosperity
- Cultural heritage

The benefit to society, economics and prosperity, and cultural heritage themes which play a part in the cultivation of GM crops have not been laid down in legislation. These can be further developed and operationalized if and when it is decided that they could play a part in the individual assessment by member states on the admittance of GM crops for cultivation in their own territories. During this process experience can be gained in the application of such criteria in the admittance of GM crops, which could then also be useful for an assessment of cultivation elsewhere in the world followed by import into Europe.

5.3.2 THEMES RELEVANT TO CULTIVATION ELSEWHERE FOLLOWED BY IMPORT INTO EUROPE

All nine themes are relevant to cultivation outside Europe followed by import into Europe. Criteria which are already operationalized in Europe cannot be presumed to exist in a country outside Europe. In view of trade relations, as well as politically and legally, it is much more complex to draw up an assessment framework for sustainability for import, because other laws and rules apply outside Europe. A more ethical and political issue related to the introduction of a sustainability assessment for import, is the desirability of imposing sustainability criteria on other countries.
Under the cultural heritage theme COGEM notes that this criterion may perhaps not always apply to the same degree to cultivation within the Netherlands' own territory and to the import of a GM crop. It is open to question whether it is up to the Netherlands or Europe to determine whether another country should conserve its own cultural heritage or not. Such a situation could occur if the Netherlands or Europe were to decide not to import products from a country which chooses to introduce GM agriculture even though this is at the expense of a particular landscape or certain local applications. It is a matter of whether the conservation of cultural heritage or not should be decided by the country itself when permitting GM cultivation or not, or whether this may also be used as an argument by importing countries. Furthermore, determining the socio-eco-

nomic impact in another country or culture is a complex matter. Welfare and prosperity are general terms which on further consideration may well differ per country, culture or even religion. With the food supply theme too, it is difficult to estimate what effect the cultivation of GM crops will have on the local food supply in other countries.

5.4 APPLICATION OF CRITERIA IN AN ASSESSMENT FRAMEWORK

Besides rating and quantifying the individual aspects involved in making GMOs more sustainable in agriculture, sustainability aspects will also have to be taken into account in a broader context. Questions that may be involved here include whether GM crops have to achieve an 'adequate' score for all the criteria or just some of them, and how many that should then be. Besides the measurability of the separate indicators for the criteria, should the criteria also be weighed against one another in a practical assessment framework? This means that scores would have to be allocated to the sometimes disparate criteria in order to be able to compare them.
Not all the aspects identified can be established at an international level in the form of criteria and detailed standards. The sustainability criteria will, to some extent, have to be tailored per country, taking into account national and local legislation and regulations.[92] The size of the company or organisation to which the criteria are applied can also be taken into account. What must be avoided is that the application of sustainability criteria puts small-scale farmers or smaller businesses out of the picture, because they are unable to meet the requirements owing to bureaucratic hurdles or the costs involved in chain certification, for example.[93]

5.4.1 CULTIVATION IN THE EU

Various member states in the EU have advocated that each member state itself should be able to determine whether cultivation within its own territory may be permitted. The question is whether a European assessment framework will be drawn up or whether each country may interpret the criteria as they see fit. This could increase the divergence between European members states in terms of whether or not cultivation is permitted. Given the public controversy surrounding GMOs, the goal of a certain degree of policy consistency surrounding a sustainability assessment is an important one. Conversely, providing member states with room for interpretation may be desirable to move away from unnecessary formal obstacles and delayed procedures. Complications with co-existence regulations could arise in border regions due to major differences in policy between the member states on the admittance of GMOs. A possible way of preventing such problems, is to maintain feedback to the European Commission with regard to the reasons for permitting cultivation or not, without this leading to the same deadlock as with the safeguard clause under the present procedure.

5.4.2 CULTIVATION ELSEWHERE FOLLOWED BY IMPORT INTO THE EU

The application of European sustainability criteria to cultivation elsewhere in the world followed by import into Europe is far more complex from both a legal (WTO, trade relations) and practical (estimation of impact) point of view, than the introduction of such an assessment framework in Europe. If the various European member states were to gain experience in the operationalization of a number of sustainability criteria, this could be a useful step in the process of moving towards a broader assessment in which import is also looked at in terms of sustainability. In order to estimate the potential impact of the introduction of GM crops into the agriculture of other countries, the involvement of local stakeholders will always be very important. This is already done in a number of existing international fora, such as the RTRS, in which both experts and local stakeholders are involved. One option might be to support these initiatives and get involved in them until more experience has been gained within the European member states with regard to the incorporation of sustainability criteria in the admittance procedure for GM crops.
Another option would be to appoint a European or global committee of experts to undertake a sustainability assessment of imported crops. This will prevent major differences arising between countries in the admittance of GM crops for import and that deadlock is again reached in the decision-making process because countries cannot agree.

TABLE 5.1 **RELEVANCE OF CRITERIA TO:**	**Cultivation in Europe**	**Cultivation outside Europe followed by import into EU[1]**
BENEFIT TO SOCIETY The production of GM crops leads to an increase in yield, contributes to harvest security or offers some other form of general benefit to society.	**x**	**x**
ECONOMICS AND PROSPERITY The production and use of GM crops contributes equally to local and general prosperity and the economy and, where possible, leads to an improvement.	**x**	**x**
HEALTH AND WELFARE The production and use of GM crops means that the health and welfare of workers, the local population and consumers remains at the same level and, where possible, improves.		**x**
LOCAL AND GENERAL FOOD SUPPLY The production and use of GM crops means that the local food supply remains at the same level and, where possible, improves.		**x**

CULTURAL HERITAGE The production of GM crops offers the country or region concerned, if so desired, room to conserve and continue specific cultural heritage aspects or other local applications (such as building materials, medicines).	**x**	**x**
FREEDOM OF CHOICE The consumer and the manufacturer's freedom of choice regarding GMO (or GMO-free) is safeguarded in the production and import of GM crops.	***[2]**	**x**
SAFETY The admittance and assessment of GM crops in terms of safety to humans and the environment takes place in the country concerned in accordance with the legislation, on the basis of the international agreements in force concerning human and environmental safety.	*****	**x**
BIODIVERSITY The production of GM crops does not lead to a) a reduction in the functional biodiversity of the agricultural environment and where possible even strengthens it, and b) damage to protected or vulnerable biodiversity (including the center of origin of agricultural crops).	*****	**x**
ENVIRONMENTAL QUALITY The production and processing of GM crops means that a) the quality of the soil, surface water and groundwater, and air, does not deteriorate and, where possible, is improved and b) the emission of greenhouse gases along the entire chain (development, production, processing and transport) remains neutral or declines relative to conventional agriculture.	*****	**x**

x) Relevant.
*) Already fully or partly covered by legislation.
1) In the 'cultivation outside Europe' column an x denotes relevance in the exporting country, EU legislation will apply to import into the EU.
2) (*) Relates to the situation in the country where the cultivation takes place, inside or outside Europe.

6

CONCLUSIONS

- In this report COGEM has identified and described a number of building blocks which could play a part in an assessment framework for the socio-economic, and in a wider sense, the sustainability aspects of the application of GMOs in agriculture.

- In this report COGEM leaves aside the fundamental questions involved in the debate for and against genetic modification. It has been investigated what conditions the application of GM crops should meet to be able to contribute to more sustainable agriculture.

- COGEM notes that the reason for drawing up sustainability criteria specifically for GMOs lies not in any difference in the production or use of these crops compared with conventional crops. The criteria for GMOs are being made explicit specifically because GMOs are surrounded by public controversy.

- COGEM notes that the introduction of an assessment of the sustainability aspects of GM crops could raise questions about the sustainability of certain conventional crops and cultivation methods which, at present, are not subject to any such assessment.

- COGEM holds the view that socio-economic aspects are an essential part of the three elements of sustainable development. All aspects of these elements are closely inter-related and cannot be seen as separate from one another. This also applies to the criteria drawn up (see annex 6).

FRAME OF REFERENCE

- Conventional agriculture has been taken as the frame of reference because this form of agriculture is most common.

- A general principle in drawing up the criteria is that GM crops in agriculture should meet as well, if not better, the criteria which apply to the current non-GM variants in conventional agriculture.

CRITERIA

- COGEM has formulated nine themes and associated criteria which could serve as building blocks for an assessment framework of the sustainability aspects of GMOs in agriculture:
  1. Benefit to society
  2. Economics and prosperity
  3. Health and welfare
  4. Local and general food supply
  5. Cultural heritage
  6. Freedom of choice
  7. Safety
  8. Biodiversity
  9. Environmental quality

- The theme of safety differs from most of the other themes covered in this report. Safety is the only theme assessed on the basis of the product, the GMO itself, while most other sustainability criteria relate to the way in which the GMO is applied and used.

DISTINCTION BETWEEN APPLICATION OF CRITERIA FOR CULTIVATION AND IMPORT

- A number of the criteria drawn up relate to themes which have already been laid down in Europe in the legislation, such as safety and freedom of choice, or which are not or no longer a topic of discussion. This report looks at criteria not only for the Netherlands or Europe, but also elsewhere. Criteria which are already operationalized in Europe, cannot be presumed to exist in relation to import from a country outside Europe.

- The themes and discussion points which are most relevant to the debate on GM crops in Europe which have not yet been included in an assessment framework or regulated in any other way, are as follows:
  - Benefit to society
  - Economics and prosperity
  - Cultural heritage

- The themes which are relevant to Europe, but largely already included in the legislation are as follows:
  - Safety
  - Freedom of choice
  - Biodiversity
  - Environmental quality

- The themes of health and welfare, and local food supply are generally not a topic of discussion in Europe (anymore) and thus less relevant to the current debate on the cultivation of GMOs in Europe.

- All nine themes are relevant to cultivation outside Europe followed by import into Europe. In view of trade relations, as well as politically and legally, it is much more complex to draw up an assessment framework for sustainability for import, because different laws and rules apply outside Europe.

- A more ethical and political issue related to the introduction of a sustainability assessment for import, is the desirability of imposing sustainability criteria on other countries. It is a matter of whether the conservation of cultural heritage or not should be decided by the country itself when permitting GM cultivation or not, or whether this may also be used as an argument by importing countries.

- Furthermore, determining the socio-economic impact in another country or culture is a complex matter. Welfare and prosperity are general concepts which on further examination may well differ per country, culture or even religion.

CONSIDERATIONS FOR OPERATIONALIZATION

- Apart from the themes of safety and freedom of choice, the criteria drawn up in this report are not specific to GMOs. These are standards which a crop must meet in order to contribute to more sustainable agriculture.

- For the operationalization of the sustainability criteria it would be desirable that the indicators used to measure the criteria: a) are objectively measurable, and b) can be estimated in advance.

- To test the safety of GM crops, there is already a comprehensive risk assessment in place in which objectively measurable data are evaluated with regard to safety to humans and the environment. The results of these studies and measured values are still regularly the subject of discussion. COGEM notes that when people already cannot agree on measurable facts, in practice the introduction of socio-economic criteria will be a complex task, the implementation of which could, as far as possible, be decentralized.

- COGEM considers that if the various European member states were first to gain experience in the operationalization of a number of sustainability criteria for crops cultivated in their own territories, this might be a useful step in the process of moving towards a broader assessment in which ultimately, import is also assessed in terms of sustainability.

ANNEXES

Annex 1
Letter from Minister Cramer requesting the report

Annex 2
IETK utility/need form

Annex 3
Checklist of the Norwegian Biotechnology Advisory Board

Annex 4
Members of COGEM subcommittees

Annex 5
List of experts interviewed

Annex 6
Interconnectedness of essential elements of sustainability

ANNEX 1
LETTER FROM MINISTER CRAMER REQUESTING THE REPORT

> Retouradres Postbus 30945 2500 GX Den Haag

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T 070-3394639
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Kenmerk
RB/2009027199

Datum – 8 APR. 2009
Betreft Sociaal-economische aspecten voor ggo's

Geachte heer Zoeteman,

In 2008 is in Europees verband gediscussieerd over toelatingen van genetisch gemodificeerde organismen (ggo's) in de EU. Daarbij is ook gesproken over sociaal-economische aspecten die verbonden kunnen zijn aan ggo's en de rol die deze aspecten zouden kunnen spelen in het beoordelingsproces. In december is de voorlopige uitkomst van die discussie vastgelegd in Raadsconclusies. De uitkomst houdt onder andere in dat lidstaten tot 1 januari 2010 de gelegenheid hebben om gegevens over sociaal-economische gevolgen van ggo's naar elkaar en naar de Europese Commissie te sturen. De Commissie zal die gegevens verwerken in haar verslag van de implementatie van Richtlijn 2001/18/EG[1], dat ter verdere besluitvorming zal worden aangeboden aan de Europese Raad en het Europese Parlement. Dit betekent voor Nederland dat ik met de minister van LNV en andere betrokken ministers, een inbreng namens Nederland zal voorbereiden, die uiterlijk op 31 december 2009 gereed moet zijn.

Ik wil ten behoeve van de Nederlandse inbreng een beoordelingskader opstellen voor sociaal-economische aspecten van ggo's. Ik beoog met het beoordelingskader duidelijkheid te krijgen over welke sociaal-economische thema's een rol spelen bij activiteiten met ggo's. Ik stel me daarbij voor dat bijvoorbeeld aan teelt in de EU andere sociaal-economische aspecten verbonden zijn dan aan teelt van ggo's elders in de wereld, al dan niet gevolgd door import naar de EU. Onder sociaal-economische aspecten versta ik in elk geval duurzaamheid. Hoewel in deze discussie steeds wordt gesproken over ggo's in het algemeen, gaat het mij in deze fase uitsluitend om de sociaal-economische aspecten die verbonden zijn aan toepassingen met genetisch gemodificeerde gewassen.

Bij deze wil ik uw hulp vragen bij het opstellen van het beoordelingskader, door u te vragen om een signalering op te stellen over sociaal-economische criteria voor toepassingen van ggo's. Daarbij zou u kunnen voortborduren op andere studies en rapporten waarbij zulke sociaal-economische thema's aan de orde zijn

[1] Richtlijn 2001/18/EG inzake de doelbewuste introductie van genetisch gemodificeerde organismen in het milieu.

geweest. Ik denk daarbij aan het toetsingskader voor duurzame biomassa[2]. In dat advies is voor de productie van biomassa uiteengezet welke duurzaamheidthema's een rol spelen, welke criteria daarbij te formuleren zijn en welke indicatoren bij die thema's zijn aan te wijzen. In uw signalering zou u, voor zover mogelijk, een vergelijkbare uiteenzetting voor ggo's kunnen maken. Het referentiekader zou daarbij de conventionele landbouw kunnen zijn, waarbij de criteria gericht kunnen zijn op een minimaal gelijkwaardige of waar mogelijk verbeterde duurzaamheid.

Naast de goede expertise die reeds binnen uw commissie beschikbaar is op het gebied van ggo's en maatschappelijke aspecten, zou u ook nog externe experts kunnen raadplegen die zich hebben verdiept in de ontwikkeling van een toetsingskader dan wel criteria voor maatschappelijke aspecten van ggo's.

Uw signalering wordt meegenomen bij het opstellen van de Nederlandse bijdrage aan de EU discussie over sociaal-economische aspecten. Ik zal daarbij een voorstel doen in de EU over hoe om te gaan met sociaal-economische aspecten van ggo's, daarbij rekening houdend met de mogelijkheden en onmogelijkheden in WTO verband tot het inzetten van verschillende instrumenten. In het kader van de voorbereiding daarvan zullen LNV en VROM naar verwachting een seminar in Nederland organiseren, om ook andere belanghebbenden bij ggo's te betrekken. Uiteraard zal de COGEM voor dit seminar worden uitgenodigd.

Gelet op de planning van de bijdrage van Nederland zou uw signalering uiterlijk 1 september 2009 gereed moeten zijn. Indien dit niet haalbaar blijkt te zijn, kan in overleg met mijn medewerkers worden bezien op welke wijze hiermee kan worden omgegaan.

Ik wil u bij voorbaat van harte bedanken voor uw medewerking bij dit belangrijke onderwerp.

Hoogachtend,
de minister van Volkshuisvesting,
Ruimtelijke Ordening en Milieubeheer,

dr. Jacqueline Cramer

[2] Kamerstukken II, 2006-2007, 30305 nr 35.

Directoraat-Generaal Milieu
Directie Stoffen, Veiligheid, Straling
Straling, Nucleaire en Biovelligheid

Kenmerk
RB/2009027199

Genetic Modification Commission
The Chairman
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Ref: RB/2009027199
Date : 8 April 2009
Re: Socio-economic aspects for GMOs

Dear Mr. Zoeteman,

The admittance of genetically modified organisms (GMOs) into the EU was discussed in the European context in 2008. During the discussion socio-economic aspects which might be connected with GMOs were mentioned and the role that these aspects could play in the assessment process. In December the provisional report of this discussion was published in the Council's conclusions. The record states, among other things, that the member states have an opportunity until 1 January 2010 to send information on the socio-economic impact of GMOs to each other and the European Commission. The Commission will incorporate this information in its report on the implementation of Directive 2001/18/ECe, which will be submitted to the European Council and the European Parliament for further decision-making. For the Netherlands, this means that I, together with the Minister of Agriculture, Nature and Food Quality (LNV) and other ministers involved, shall be preparing a contribution on behalf of the Netherlands, which must be ready by 31 December 2009 at the latest.

For the purposes of the Netherlands' contribution I would like to draw up an assessment framework on the socio-economic aspects of GMOs. My aim with the assessment framework is to create clarity about which socio-economic themes may be involved in activities relating to GMOs. I would imagine, for example, that different socio-economic aspects will be associated with cultivation of GMOs in the EU than elsewhere in the world, possibly followed by import into the EU. By socio-economic aspects I am referring, in any event, to sustainability. Although in the discussion it is always GMOs in general that are spoken of, for me at this stage it is purely about the socio-economic aspects that are connected with applications using genetically modified crops.

e *Directive 2001/18/EC on the deliberate introduction into the environment of genetically modified organisms.*

I would therefore like to ask for your help in drawing up the assessment framework, by asking you to prepare a report on the socio-economic criteria for the application of GMOs. For this you could also draw on other studies and reports which also dealt with such socio-economic themes. In this context, the assessment framework for sustainable biomass comes to mindf. That report sets out which sustainability themes are involved in the production of biomass, what criteria can be formulated for this and what indicators can be designated for these themes. In your report you could, in so far as this is possible, make a similar comparison for GMOs. The frame of reference for this might be conventional agriculture, in which the criteria could be aimed at a level of sustainability which is at least the same or better where possible.

Besides the high-quality expertise which is already present within your commission in the area of GMOs and societal considerations, you could also consult external experts who are closely involved in the development of either an assessment framework or criteria for the public interest aspects of GMO.

Your report will be used when drawing up the Netherlands' contribution to the EU debate on socio-economic aspects. I will be making a proposal to the EU about how to deal with the socio-economic aspects of GMOs, taking into account what is and is not possible in the context of the WTO with regard to the deployment of various instruments. As part of the preparations for this, it is expected that a seminar will be organised in the Netherlands by the Ministries of Agriculture, Nature and Food Quality (LNV) and Housing, Spatial Planning and the Environment (VROM), also to involve other parties with an interest in GMOs. COGEM will, of course, be invited to this seminar.

In view of the planning related to the Netherlands' contribution, your report needs to be complete by 1 September 2009 at the latest. If this turns out not to be feasible, in consultation with my staff, it can be determined how we can deal with this.

I would like to warmly thank you in advance for your kind assistance in this important matter.

Yours sincerely,
The Minister of Housing, Spatial Planning and the Environment,

Dr. Jacqueline Cramer

f Parliamentary documents II, 2006-2007, 30305, no. 35.

ANNEX 2
IETK UTILITY/NEED FORM

The need/risk form from the COGEM report 'Towards an integrated framework for the assessment of social and ethical issues in modern biotechnology' included the following questions:

- What is the added value of the product to your business?
- What is the added value of the product to the production chain?
- What is the added value for the consumer?
- What added value do you envisage for the environment?
- What demand do you envisage that the product meets?
- What are the risks to the production chain?
- What are the risks to the people in your organisation and the production chain who work directly with your product?
- What are the risks to the consumer in the event of chronic use?
- What are the risks to the environment?
- What are the risks to the agricultural and ecosystem?
- What socio-economic consequences do you envisage for the Netherlands, Europe and worldwide?
- How, in your view, does the added value of the product compare in relation to the risks associated with it?
- What precautionary measures has the company taken?
- Is the product the result of in-house development or a joint venture?
- Does the company give consideration to ethical and public interest issues?
- Are you in any way involved in the public debate on biotechnology?

ANNEX 3
CHECKLIST OF THE NORWEGIAN BIOTECHNOLOGY ADVISORY BOARD

Source: Norwegian Biotechnology Advisory Board 2003.[40]

Sustainability

Global effects

- Is biodiversity affected on a global scale?
- Is the functional capacity of ecosystems affected?
- Do these effects differ between production and use?

Ecological limits

- Is the efficiency of energy use affected?
- Is the efficiency of other natural resource use affected?
- Is the distribution between the use of renewable and non-renewable natural resources affected?
- Are discharges of pollutants with a global/transboundary range affected?
- Are emissions of greenhouse gases especially affected?
- Do these effects differ between production and use?

Basic human needs

- Is the fulfilment of basic human needs affected?
- Do these effects differ between production and use?

Distribution between generations

- Is the distribution of benefits between generations affected?
- Is the distribution of burdens between generations affected?
- Do these effects differ between production and use?

Distribution between rich and poor

- Is the distribution of benefits between rich and poor countries affected?
- Is the distribution of burdens between rich and poor countries affected?
- Do these effects differ between production and use?

Economic growth

- Is economic growth's demands on energy and other natural resources affected?
- Are economic growth's global/transboundary environmental impacts affected?
- Is economic growth's distribution between rich and poor countries affected?
- Do these effects differ between production and use?

Benefits

Product characteristics

- Is it reasonable to say that there is a need for the product in terms of demand or otherwise?
- Is it reasonable to say that the product will solve or possibly contribute to solving a societal problem?
- Is it reasonable to say that the product is significantly better than equivalent products already on the market?
- Is it reasonable to say that there are alternatives that are better than the product in terms of solving or possibly contributing to solving the societal problem in question?

Production and use of the product

- Among the relevant aspects to be considered are:
- Does the product contribute to creating new employment opportunities in general and in rural areas in particular?
- Does the product contribute to creating new employment opportunities in other countries?
- Does the product create problems for existing production whose existence should otherwise be preserved?
- Does the product create problems for existing production in other countries?

Ethical considerations

Ethical norms and values associated with humans

- Does the authorization/prohibition of the product and its production and use comply with the ethical principles of the population at large?
- Does the product or its production and use conflict with ideals of human solidarity and equality, especially in relation to the safeguard of weaker groups of society?
- Indigenous peoples, people with strong traditional cultures and weaker groups of society may be exposed to serious adverse consequences of the decisions of mainstream society. The interests of such groups in being allowed to control their own cultural change should be taken into special consideration.
- Does especially the marketing and sale of the product conflict with such norms and values?

Eco-ethical considerations

- Do the product or its production conflict, by their very nature, with any intrinsic value of animal species?
- Does the production of the product cause unnecessary suffering to animals?
- Does the production of the product result in any transgression of barriers between species in ways that are materially different from what otherwise occurs in cultivated or wild nature and that must be considered incompatible with the value ascribed to the segregation of species?

ANNEX 4
MEMBERS OF COGEM SUBCOMMITTEES

Executive Board

Chairman: Prof. dr. ir. B.C.J. Zoeteman

- Dr. F.W.A. Brom, Ethics, Rathenau Institute
- Prof. dr. R.A.M Fouchier, Virology, Erasmus Medical Centre (deputy chairman)
- Dr. ir. H.J. Schouten, Plant Breeding, Wageningen University Research Centre
- Ms. Prof. dr. L. van Vloten-Doting, Knowledge Cooperative
- Prof. dr. ir. B.C.J. Zoeteman, Sustainability policy in the International Context, University of Tilburg

Subcommittee on Ethics and Social Aspects

Chairman: Dr. F.W.A. Brom

- Dr. F.W.A. Brom, Ethics, Rathenau Institute
- Prof. dr. J.J.M. Dons, Biotechnology, BioSeeds
- Prof. dr. R.A.M Fouchier, Virology, Erasmus MC
- Prof. dr. F.W.J. Keulartz, Applied Philosophy, Wageningen University / Radboud University Nijmegen
- Ms. Prof. dr. ir. E.T. Lammerts van Bueren, Biological plant breeding, Louis Bolk Institute / Wageningen University
- Ms. Prof. dr. M. Margadant-van Arcken, Nature and Environmental education
- Drs. L. van den Oever, Biology, Netherlands Institute for Biology (NIBI)
- Ms. Prof. dr. P. Osseweijer, Biotechnology and society, scientific communication, Kluyver Centre for Genomics of industrial Fermentation / TU Delft
- Ms. Dr. S. Roeser, Ethics, 3TU centre for ethics and technology / TU Delft
- Prof. dr. G.T.P. Ruivenkamp, Sociology, Societal aspects of biotechnology, Wageningen University / Free University Amsterdam
- Dr. ir. H.J. Schouten, Plant Breeding, Wageningen University Research Centre
- Dr. J.A.A. Swart, Ethics and societal aspects of the life sciences, Groningen University
- Ir. H.C. de Vriend, Consumer issues and communication, LIS Consult
- Drs. T.J. Wams, Nature Conservation, Vereniging Natuurmonumenten
- Prof. dr. H.A.E. Zwart, Philosophy and Science Studies, Radboud University Nijmegen

Subcommittee on Agricultural Aspects

Chairman: Dr. ir. H.J. Schouten

- Prof. dr. ir. G.C. Angenent, plant physiology, Wageningen UR
- Prof. dr. W. van Delden, Population genetics, Groningen University
- Prof. dr. M. Dicke, Insect-Plant Interactions, Wageningen UR
- Ms. Prof. F. Govers, Molecular phytopathology, Wageningen UR
- Dr. T.J. de Jong, Plant Ecology, Leiden University
- Dr. J.M. Kooter, Epigenetics, Free University Amsterdam
- Dr. J.C.M. den Nijs, Biodiversity / Ecosystem dynamics, University of Amsterdam

- Ing. A.J.W. Rotteveel, Plant Pathology / Weed Research, Plant Protection Service Wageningen
- Dr. ir. H.J. Schouten, Plant Breeding, Wageningen UR
- Dr. ir. B.A. Uijtewaal, Plant Breeding, Cell biology, Regulatory affairs, Nunhems Zaden (seeds)

Subcommittee on Medical and Veterinary Aspects

Chairman: Prof. dr. R.A.M Fouchier

- Prof. dr. dr. A. van Belkum, Medical microbiology, Erasmus University Rotterdam
- Ms. Prof. dr. C.D. Dijkstra, Neuro-immunology, Free University Amsterdam
- Prof. dr. R.A.M Fouchier, Virology, Erasmus MC
- Dr. R.J. de Groot, Virology, Utrecht University
- Prof. dr. P.W.M. Hermans, Medical microbiology, Radboud University Nijmegen
- Prof. dr. R.C. Hoeben, Molecular Virology, Leiden University Medical Centre
- Ms. Dr. G.A.P. Hospers, Oncology / Gene therapy, Groningen Academic Hospital
- Dr. T.G. Kimman, Virology, National Institute for Public Health and the Environment (RIVM)
- Ms. Dr. N.A. Kootstra, Virology / Immunology, CLB-Sanquin Amsterdam
- Dr. C. van Maanen, Animal virology, Animal Health Service
- Dr. B.P.H. Peeters, Animal virology, ID-Lelystad
- Dr. ir. M.W. Weststrate, Vaccine production, Netherlands Vaccine Institute

ANNEX 5
LIST OF EXPERTS INTERVIEWED

In drawing up this report COGEM aimed to incorporate a wide range of expertise and to throw light on the differing approaches and perspectives. For this purpose a number of interviews were conducted with experts on agricultural development and sustainability which served as input for the report. COGEM would like to express its particular thanks to following people for their contribution:

Frans Claassen	Director Product Board for Margarine, Fats and Oils
Frans Köster	Senior policy adviser, Product Board for Margarine, Fats and Oils
John Verhoeven	Manager vegetable, LTO North (Agribusiness association)
Prem Bindraban	Director World Soil Information (ISRIC), Plant Reserch International / WUR researcher
Bart Jan Krouwel	Former director socially responsible investing, Rabobank
Alois Clemens	Head Forestprogramme's, WWF, the Netherlands
Henk van der Zeijts	Senior policy researcher, Netherlands Environmental Assessment Agency (PBL)

Naturally, COGEM would like to point out that the interviews were conducted in order to gather input for the report. The people interviewed are not responsible for the contents of this report, nor was the report submitted to them in advance for their approval and comments.

ANNEX 6
INTERCONNECTEDNESS OF ESSENTIAL ELEMENTS OF SUSTAINABILITY

MATRIX: INTERCONNECTEDNESS OF ELEMENTS OF SUSTAINABILITY	PEOPLE	PLANET	PROFIT
BENEFIT TO SOCIETY The production of GM crops leads to an increase in yield, contributes to harvest security or offers some other form of general benefit to society.	x	x	x
ECONOMICS AND PROSPERITY The production and use of GM crops contributes equally to local and general prosperity and the economy and, where possible, leads to an improvement.	x		x
HEALTH AND WELFARE The production and use of GM crops means that the health and welfare of workers, the local population and consumers remains at the same level and, where possible, improves.	x		x
LOCAL FOOD SUPPLY The production and use of GM crops means that the local food supply remains at the same level and, where possible, improves.	x		
CULTURAL HERITAGE The production of GM crops offers the country or region concerned, if so desired, room to conserve and continue specific cultural heritage aspects or other local applications (such as building materials, medicines).	x		

	PEOPLE	PLANET	PROFIT
FREEDOM OF CHOICE **The consumer and the manufacturer's freedom of choice regarding GMO (or GMO-free) is safeguarded in the production and import of GM crops.**	x		
SAFETY **The admittance and assessment of GM crops in terms of safety to humans and the environment takes place in the country concerned in accordance with the legislation, on the basis of the international agreements in force concerning human and environmental safety.**	x	x	
BIODIVERSITY **he production of GM crops does not lead to a) a reduction in the agrobiodiversity of the agricultural environment and where possible strengthens it, and b) damage to protected or vulnerable biodiversity (including the center of origin of agricultural crops).**		x	
ENVIRONMENTAL QUALITY **The production and processing of GM crops means that a) the quality of the soil, surface water and groundwater, and air, does not deteriorate and, where possible, improves and b) the emission of greenhouse gases along the entire chain (development, production, processing and transport) remains neutral or declines relative to conventional agriculture.**		x	

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