# **Global Motivation or European Character?**

Four Scenarios for GMOs in European Agriculture





#### Colophon

This is a joint publication of the Netherlands Commission on Genetic Modification (COGEM) and the Rathenau Instituut

December 2010

Design: Avant la Lettre, Utrecht Illustrations: Fallen Serenity Productions

© COGEM, Rathenau Instituut, 2010

Parts from this publication may be reproduced for non-commercial purposes, provided that the source is acknowledged: Netherlands Commission on Genetic Modification (COGEM), Rathenau Instituut, 2010. Global Motivation or European Character? Four Scenarios for GMOs in European Agriculture. COGEM, Bilthoven

# Summary

The past ten years have seen a steady growth in the acreage of genetically modified (GM) crops in the world, and it looks like a trend for the future. Thereby the quantity and number of GM products in the global market will greatly increase. Within Europe, however, hardly any GM crops are grown, due to a strong public opinion against GM crops. The current gap between the developments within and outside of Europe raises the question of what Europe's and the Netherlands' future positions will be with regard to genetic modification in agriculture, and what choices and policy questions are paired with this.

The Rathenau Instituut and the COGEM have therefore performed an explorative scenario study on the situation for GMOs in European agriculture. Based on two 'drivers' – 'societal acceptance in the EU (and the Netherlands)' and 'external pressure' – which are both determining factors for developments as well as uncertainty surrounding the direction in which they are developed, four scenarios or worlds can be distinguished. In all scenarios, the Netherlands and Europe are projected within the framework of a world that does cultivate GMOs, just like in the current situation.

In the first scenario, 'GMOs for Luxury', no external pressure or necessity for cultivating GM crops in Europe exist, and at the same time, societal acceptance is widespread. Consumers can choose for both GMO and GMO-free in combination with a plethora of certification marks that concern health and sustainability claims. In this scenario, the biobased economy gets ample opportunity for growth.

When external pressure for cultivating and importing GM crops as well as widespread societal acceptance are present, the scenario 'Global Motivation' can take place. The global production of food must gear up and all possible means are brought into action. Most consumers see genetic modification as an important factor in solving global problems with food security. GM products can be found in the shops in abundance and labelling is secondary.

In the third scenario, 'European Character', no external pressure to cultivate GM crops in the Netherlands or Europe exists. Partially because there is a strong societal opposition against GM crops, Europe closes its borders for import. Products that are GMO-free can be bought on the global market at higher prices. Products on the global market that are no longer available GMO-free can still be produced in Europe. Even without applying genetic modification, innovations are made in the field of crops and biomass production. The last scenario, 'Costly Ideals', puts the Dutch and European governments in a difficult position between food security and societal opposition to GMOs. In this scenario, a worldwide insufficient food supply gives rise to strong external pressure to cultivate GMOs, while there is little societal acceptance in Europe. Conventional products are priced high and for a part of all consumers they are no longer affordable. The government is under great pressure to make choices.

The scenarios offer a perspective on the consequences that the (lack of) cultivation and importation of GMOs can have on agriculture, science, business and consumers in the Netherlands and Europe. The scenarios sketch extremes and they are not predictions of the future. They are snapshots of fictional worlds under the conditions set by the drivers societal acceptance and external pressure. As such, they offer a mental framework for identifying relevant policy questions and giving shape to future policies, within each different situation.

# Contents

1. Introduction	7
1.1 Scenario development	8
1.2 Workshop scenario studies	9
1.3 Driver 1: societal acceptance of GMOs in the EU	10
1.3.1 Acceptance influenced by risk (perception) and product benefit	10
1.3.2 Apprehension, lack of benefits, and incidents as reasons for low acceptance	11
1.4 Driver 2: External pressure	12
1.4.1 Social, economic, political and ecological pressure	12
1.4.2 No external pressure: world food supply suffices	14
1.5 Current situation as a starting perspective	15
1.6 Identification four scenarios	16
2. Scenario 1: GMOs for Luxury	19
2.1 Innovative products increase consumers' freedom of choice	20
2.2 Businesses are focused on consumer advantage GM crops	21
2.3 Science as a source for new innovations and talent	22
2.4 Government validates claims of new products	22
2.5 Conditions for the scenario GMOs for Luxury and challenges for government policy	23
3. Scenario 2: Global Motivation	26
3.1 Consumers put aside choosiness for global problems	27
3.2 Businesses give their all for food security	28
3.3 Science and business join forces	28
3.4 Government protects safety and food security	29
3.5 Conditions for the scenario 'Global Motivation' and challenges to government policy	30
4. Scenario 3: European Character	33
4.1 Consumers can choose from a broad GMO-free selection	34
4.2 Businesses see opportunities for a product selection without genetic modification	35
4.3 EU scientists innovate with GMO-free uses	35
4.4 Government expands possibilities for self-sufficiency	36
4.5 Conditions for the scenario 'European Character' and government challenges	36

5. Scenario 4: Costly Ideals	40
5.1 Majority of consumers can no longer choose	41
5.2 Businesses see self-sufficiency limits draw closer	42
5.3 Science pushes policy limits	42
5.4 Government divided between food security and freedom of choice	43
5.5 Conditions for the scenario 'Costly Ideals' and challenges to government policy	44
6. Conclusion and Discussion	46
6.1 Four scenarios for GMOs in agriculture	46
6.2 Expectations of future unjustly overshadow other scenarios	47
6.3 Dynamics of scenarios shed light on choices	48
6.3.1 Core themes for the future of GMOs in European agriculture	49
6.3.2 Choices on innovation, security and sustainability influence food security	49
6.3.3 Choices on innovation, food prices and unintentional crossbreeding with GMOs	
influence freedom of choice	50
6.4 Conclusions	51
References	52
Appendix 1	53

# 1. Introduction

Within the EU, a long-term impasse appears to exist surrounding the cultivation of genetically modified (GM) crops. Partially due to pressure from a public opinion opposed to GM crops, various EU countries are blocking the issue of new cultivation permits. In 2010, for the first time in twelve years, a GM crop was accepted for cultivation.<sup>1</sup> The question remains whether the acceptance of this GM potato will signify a breakthrough in this impasse. It does seem to have set off the debate surrounding the cultivation of GM crops afresh.

So far, the debate in Europe has focused on safety aspects, although supposedly other arguments exist for voting against allowing GM crops onto the market, such as objections of principle or socioeconomic aspects. In a reaction to this, the European Commission has suggested that each EU member state is authorized to decide on the cultivation of GM crops on national territory.<sup>2</sup> Initially, such a decision could be made on considerations for the coexistence of conventional and genetically modified foods. Moreover, it has been suggested to adjust the European Directive (2001/18) concerned to the extent that such a decision can be made on more than considerations for safety. Earlier, on request of the minister of VROM, the COGEM drafted sustainability criteria that could possibly play a role in this assessment process.<sup>3</sup> Meanwhile, outside of Europe the acreage of GM crops continues to increase.

This raises the question which position Europe will hold in the future with regard to the separate member states and with regard to the rest of the world. And derived from this, what developments can take place in the Netherlands itself?

In visions of the future on agriculture and the world food supply, often a single image predominates which may cause tunnel vision. The tenor of many reports that appeared in the media over the past period is that the world population will continue to grow and consume an increasing amount of animal products, causing a strongly increased demand on food production. Moreover, agriculture will suffer from a changing climate, which will have consequences for the yields. A number of reports emphasize that genetic modification is indispensable as a partial solution for feeding the world population. This sketch of the future is portrayed as unavoidable and governments are called upon to act. Other possibilities and options that at this moment may seem less likely are thereby over-shadowed. Through unexpected developments, however, other scenarios may unfold. The scenarios in this report encourage thinking about other futures that, based on an extrapolation of current trends, can be expected. In this report, four scenarios are drawn up that use the key uncertain factors in the current situation surrounding GMOs in Europe as a starting point. Based on two 'drivers' that are both influential and uncertain, four worlds are sketched with regard to GMOs in Europe. Moreover, these scenarios show what choices and policy questions may arise in the possible future scenarios, depending on which drivers become dominant.

## 1.1 Scenario development

With the help of scenarios, possible situations for the future can be mapped. These visions of the future can be aimed at the timely anticipation of change in dynamic surroundings, for example by thinking up various strategies ahead. Scenario studies can broaden one's mind and help to think outside the box. Strategies that are thought up during the various scenarios can be focused on both avoiding and bringing about a scenario. A special version of the latter, concentrated on desirable technological innovations, is also known as backcasting.

Three types of scenario development can be distinguished globally: normative, extrapolative and explorative. Normative scenarios assume a specific (normative) wish; extrapolative scenarios mostly assume current trends. Lastly, explorative scenarios assume possible future uncertain factors and their impact. This report is about explorative scenario development with a *foresight* character, where two drivers are taken as a starting point. These drivers are both uncertain and can have a big impact on the situation surrounding GMOs in Europe. Where purely explorative scenarios will assume a future that cannot be predicted (with many uncertainfactors that play a role in the current situation.<sup>4</sup> Through the involvement of various types of stakeholders in the workshop, the scenarios reflect whatever is current in the field of biotechnology. A number of factors and examples of what is current today can be found back in the future scenarios, weakened or actually magnified.

Each scenario must offer a plausible vision of the future that helps to prepare for different situations, regardless of which situation is most realistic. The scenarios must also stimulate debate on the desirability of various futures and corresponding policy options. The scenarios depict extremes that will probably be more nuanced in reality. These extremes, however, do offer a window for forming an own opinion, so ultimately, one can anticipate the future and (unexpected) changes in a flexible manner.<sup>5</sup>

Scenarios that have been built with the most influential and uncertain drivers as a starting point do justice to a situation in which circumstances and actors influence each other. Next to sketching

various worlds, one could think about the consequences these can have for people, but also for, for example, the environment or the economy. A next step is to think about the choices that will have to be made in these worlds, and which policy questions apply in these situations. Moreover, one can see which policy initiatives are relevant, regardless of the scenario.

### 1.2 Workshop scenario studies

On 13 May 2009, the COGEM and the Rathenau Instituut organized an expert meeting, which used a *Group Decision Room* (GDR) session to identify and flesh out four scenarios for GMOs in Dutch and European agriculture (see Annex 1). The goal of the scenario development in the expert meeting was to identify the key uncertain factors in the current situation surrounding GMOs in Europe. The development of the scenarios can roughly be divided into four steps: (1) listing uncertain factors and their impact, (2) identifying the two aspects with the biggest uncertain factor and the biggest impact, (3) elaborating the scenarios. During the expert meeting in 2009, attention was mostly paid to the first three steps. Based on the meeting's output, the COGEM and the Rathenau Instituut subsequently worked out step four together.

During the GDR session, various factors were identified that influence the choice of whether or not to use or introduce GMOs in Dutch agriculture. The two factors that scored highest on impact and degree of uncertainty in their development form the axes (drivers) for the four scenarios. The first driver is 'societal acceptance in the EU (and in the Netherlands)'. The second uncertain but influential driver was initially identified as 'economic pressure'. This driver was later reformulated as 'external pressure'. The discussion showed that agricultural pressure (plagues, climate) cannot be put on a par with economic pressure (food prices, shortages). Moreover, there will always be economic pressure in the shape of free markets, also in a time when no forceful external factors are present. Both drivers formed the axes for further scenario development, where societal acceptance functioned as the X-axis and external pressure as the Y-axis.

It must be noted that the drivers in this scenario study do not function as independent or autonomous processes. Societal acceptance is not completely independent from, for example, the political or economic situation, and various processes also influence external pressure. Both drivers can be influenced, even if they are not makeable.

## 1.3 Driver 1: societal acceptance of GMOs in the EU

Societal acceptance is identified as a factor that has a large influence on developments in the field of GM crops in Europe. A frequently heard argument against accepting GM crops is that citizens and consumers do not want this. Various studies, such as the Eurobarometer, monitor social attitudes with regard to GMOs, including GM food and GM crops. The results of these kinds of research vary, but generally point to little consumer acceptance of GMOs in Europe.<sup>6</sup> The attitude of producers with regard to GMOs is more ambivalent. In the Netherlands, producers' acceptance seems to increase, with the exception of the organic sector.<sup>7</sup> Some expect that GM products that have a direct benefit to the consumer, for example health-wise, will win them over. An incident concerning GMOs such as unintentional crossbreeding with conventional crops or the escape of a genetically modified virus from a laboratory can, however, turn public opinion the other way.

The following sections elaborate on the driver 'societal acceptance'. The extremes of this axis, complete acceptance or the absence of acceptance, are described, and a number of reasons are listed that could cause such situations.

#### 1.3.1 Acceptance influenced by risk (perception) and product benefit

When a scenario portrays high societal acceptance for GMOs, this means that a large majority of the population does not consider GMOs debatable or controversial. No active debate is taking place on the subject any longer. Once they are accepted onto the market, GMOs are considered just as safe as conventional foods. Consumers see GMOs and products that contain GMOs as part of the shop selection and there is no threshold or condition for GMOs to be commercialized. GMOs appear on the market when they offer a benefit for producer or consumer. GMOs that are profitable are part of foods and products on offer in shops. The acceptance of GMOs can have various reasons. A number are listed here, such as risk perception, the weighing of the products' pros and cons and the shift of public debate to another subject.

#### **Risk** (perception)

GMOs are subjected to an extensive risk analysis and only put on the market when they are deemed safe for people and the environment. Yet, in the current situation, there is a fear that GMOs may bring health or environmental risks in the long term. Conventional products that are on the market are also not risk-free, either, but they have a so-called accepted risk. Products such as nuts or cow's milk can, for example, cause strong allergic reactions in some. Luxury goods such as alcohol and tobacco, too, of which it is known that they pose risks to health, are still being sold and not taken off the market. (Too) much sugar or fat in food can also pose health risks, as can the consumption of some raw products. This is general knowledge and no longer a current issue in debate. These prod-

ucts can simply be found on supermarket shelves, and so one may speak of an accepted risk. When the risk (perception) of GM foods is equal to other, conventional products, one could speak of an acceptance of GMOs. The reason for this could be the acceptance of a certain kind of risk, a lack of incidents that confirm the risks, or higher trust in institutions that assess the safety of GM products.

#### Product benefit

Another reason for accepting GMOs could be their benefits to producers (profit, cuts in production costs) and/or consumers (taste, looks, better best-before dates, health benefits or price). Possible benefits of GM crops could play a part alongside risk (perception), but also counterbalance these risks (i.e. increase the risk accepted).

#### Shift of public debate to another subject

Finally, a shift of public debate to other, new developments in the food and product industry (such as nanotechnology or meat consumption) can take place, giving a false impression that acceptance is higher. In reality, however, we may speak of a temporary consumer disinterest, which may always take another turn when new developments bring the subject back into the spotlight.

#### 1.3.2 Apprehension, lack of benefits, and incidents as reasons for low acceptance

When there is a low societal acceptance of GMOs, it means that a majority of the population does not accept them, or only under certain conditions. GMOs are therefore hardly available in super-markets, or not at all. A number of possible reasons for a low acceptance of GMOs are listed here.

#### **Beliefs on naturalness**

Principle and religious considerations are returning arguments for a specific group of people for not accepting GMOs. These arguments are focused on, for example, the notion of humans 'playing God' by genetically modifying plants and animals in ways that cannot be achieved through natural crossbreeding. The unnaturalness of GMOs is also often emphasized in debate. Unnatural organisms that are not found in nature are, in this context, directly seen as potentially hazardous, unhealthy and undesirable. Religious arguments and arguments of principle are quite constant and little subject to change. Other reasons for a low acceptance of GMOs are subject to change, however, and dependent on, for example, government, media and the particular day and age.

#### Incidents

GMOs and products with GMO constituents are seen as potentially risky by European law, and therefore subjected to an extensive safety assessment as a precaution. This does not apply to many conventional products or crops that have been improved through classical plant breeding. When the (perceived) risks of GMOs are bigger than those of other, conventional products, societal acceptance of these products will stay out or be lower. Incidents involving GMOs that are highlighted (and sometimes magnified) by media confirm (the risk perception) to consumers that GMOs are not safe. Incidents where conventional and GM products are unintentionally crossbred or a (genetically modified) virus escapes from a laboratory may contribute to a decrease in societal acceptance.

#### **Role of multinationals**

A last reason for a low acceptance is not specific to GMOs, but it is related, or it is seen as an undesirable development in combination with other factors. We speak of consumers' apprehension concerning multinationals that market GMOs. There is a fear that a few large corporations will dominate the food chain and exert political and economic pressure using their monopoly. Genetically modified crops that are tolerant to certain pesticides can increase the dependency of farmers on a number of large corporations. Apprehension regarding the motivation and power of multinationals can be another reason for a low acceptance of GMOs.

## 1.4 Driver 2: External pressure

A second uncertain but influential driver is 'external pressure'. External pressure is a broad concept that can be interpreted in various ways. In this report, a distinction is made between external pressure in the shape of social pressure, economic pressure, political pressure and ecological pressure. In the following sections, various causes are named that may lead to external pressure. Moreover, the other extreme of the driver external pressure will be discussed, namely the absence of external pressure.

#### 1.4.1 Social, economic, political and ecological pressure

When external pressure for growing GMOs is present, this may be because there is a threat to the food supply or to the environment. For this it is assumed that GM crops can contribute to a secure harvest, or a higher yield. External pressure can also be based on an economic factor, for example because conventional, GMO-free products are becoming too expensive. In the following paragraphs, a number of possible causes are listed that can lead to changes in external pressure. These factors can take place separately or jointly.

#### Social pressure through population growth

Population growth can lead to insufficient food production. This means that agricultural produce must increase either through a higher yield per hectare, or through an expansion of farmland. Through population growth, however, pressure on the farmland will also increase because of urbanization. Fresh water will also become scarcer, making agriculture more difficult. In order to increase

the yield per hectare, various means can be employed, such as modern agricultural methods, the use of artificial fertilizers and pesticides, or the development of new crops with improved characteristics. A change in diet, with less animal protein, could also contribute to a higher availability of (vegetable) food. However, if population growth is accompanied by an increase in average prosperity, it is likely that more animal protein will actually be consumed.

With a steady population growth, the deployment of one or a few of the methods described could possibly suffice. However, if the population grows explosively and a change in diet takes place through increased prosperity, it is more likely that all means described will have to be brought into action to produce a sufficient amount of food.

#### Economic pressure through increased food prices

External pressure can be caused by the market if food prices rise or when the centre of food consumption shifts. Such economic external pressure can take place in combination with another cause, such as insufficient global food production. Europe is not self-sufficient, and dependent on import from the rest of the world. Shortages will make prices rise and this will ultimately affect consumers. This may increase economic pressure.

Economic pressure can also take place when the economy thrives, however. In general, the consumption of animal products such as meat and milk will increase when prosperity increases. The production of 1kg of animal protein requires an average of 4kg of vegetable protein. This means that agricultural production must increase significantly when the demand for animal products rises. The price of animal products will then rise, and this can cause economic pressure. Moreover, the purchasing power of Europe and the United States may decrease, due to the fact that the economic centre is shifting to Asia.

#### Political pressure through conflicts WTO

Next to economic pressure, external pressure can take place on the political level. The four scenarios in this report are sketched against the backdrop of a world that cultivates GMOs. In the current situation, where Europe's acceptance of GMOs is low and they are hardly cultivated there, this has led to trade conflicts with the rest of the world on, among other things, WTO rules.<sup>8,9</sup> Increasing differences between Europe and the rest of the world can lead to political pressure in future, or even sanctions imposed by the rest of the world.

#### Ecological pressure through agronomic problems and natural disasters

Finally, external pressure can come from the ecosystem. Even if the world population is not increasing, there is a possibility that existing farmland will become unsuitable through climate change (droughts, floods, salinization), causing a decrease in food production. Natural disasters such as floods, tsunamis, volcano eruptions and earthquakes can (temporarily) bring disorder to food production. One can also imagine scenarios where diseases or plagues have a drastic impact on the production of the most common crops.

#### 1.4.2 No external pressure: world food supply suffices

If there is no external pressure to cultivate GMOs, the food supply is not in danger and even from an environmental perspective there is no pressure to cultivate these crops. This means that sufficient amounts of food are being produced for the population of both Europe and the rest of the world. It can also mean that at least Europe has sufficient food. Europe does not have to be self-sufficient as such, but it may simply have sufficient (financial) means to ensure the import of food products. It is not unthinkable that Europe, just like in the current situation, is still dependent on import from the rest of the world. When Europe does have enough food at its disposal because of financial means while other parts of the world have a food shortage, this may cause moral pressure to European citizens.

The absence of external pressure does not preclude the production of GM crops. These will be commercialized if there is a market for them; in other words, if they offer benefits to consumers or producers. The following paragraphs list causes that may lead to the absence of external pressure. These factors can take place separately or jointly.

#### Efficient and productive agricultural system

The presence of an efficient and productive agricultural system, such as presently can be found in parts of the world, is a situation where no external pressure exists. In the most ideal case, this system offers sufficient production to feed the world population, also if this population is growing. The efficiency of agricultural production can improve through the application of modern agricultural methods and the use of artificial fertilizer and pesticides in developing countries. New, improved crop varieties that have been crossbred naturally are more resistant to diseases and plagues and provide higher yields. These new varieties are also more resistant to droughts or floods, keeping production up to standard. Moreover, this enables a worldwide increase in usable farmland.

#### Sufficient food for the world population

Conversely, it is possible that agricultural production does not have to go up, because the world population decreases. This means that the existing production is sufficient for feeding the population. Theoretically, a global pandemic could lead to stagnation in population growth or in the extreme case, population decrease. Less drastic is a situation where a change in diet takes place,

causing increased efficiency in food production, meaning more food will be left over. A significant decrease in meat consumption, and therefore a decrease in cattle feed usage, could contribute – but not exclusively lead – to a sufficient worldwide food production even when the population continues to grow.

#### Money plays no part (in Europe)

Even when the world population is not decreasing and food production is not increasing, it is possible that Europe does not experience any external pressure to cultivate GM crops. Europe is prosperous and capable of paying higher prices for food when they rise because of a shortage in the rest of the world. An increased prosperity can help Europe bridge periods of food shortage through paying higher prices for imported products.

### 1.5 Current situation as a starting perspective

In all scenarios, the Netherlands and Europe are projected within the context of a world that does cultivate GMOs, just like in the current situation. At the moment, Europe has an efficient agricultural system without GMOs, where sufficient is being produced if not imported. Most agricultural products that are not cultivated in Europe are imported GMO-free. Hardly any GM crops are being cultivated in Europe and societal acceptance is low. Import of GM crops does take place, mostly as a resource for cattle feed. In other parts of the world the acreage of GM crops steadily increases. In some countries, GM crops even make up the bulk of total production, and no societal resistance against this kind of agriculture exists. Separating and labelling GM products in these countries is not always compulsory or has little priority. This can cause problems in export to Europe, where GM products do always have to be labelled. Europe has trade conflicts with other countries on the compliance with WTO rules. This situation forms the perspective from which the four scenarios are viewed. A second point of departure is the fact that the government as representation of the people will, in principle, act according to societal acceptance with regard to its policy towards GMOs.

This report is on the role of GMOs in European agriculture, and thus it is mostly this technology that is singled out in the scenarios. With an increasing world population or a decrease in food production, however, technological advancements in other fields will not stand still, either. Increasing food production through organic or conventional agricultural techniques and crop improvement can also contribute to this. Moreover, non-technical solutions, such as a change in diet, can play a part. The scenarios are built on the notion that all agricultural methods, including genetic modification, have the potential to contribute to the improvement of worldwide food production.

# 1.6 Identification four scenarios

Based on the drivers 'societal acceptance' and 'external pressure', four scenarios have been identified (see figure 1). The scenarios are elaborated in the coming chapters, where a few features are discussed, such as the relation Netherlands-EU-world, the relation consumer-food, the dominant GM crops/techniques in the Netherlands, the position of multinationals, science, and critical societal groups. Moreover, attention is paid to the core subjects in public debate, the role of the media, and the government standpoint. A good scenario study requires each future sketched to be plausible. The axes are therefore not completely dichotomous; in all scenarios they depend on a situation where, concerning societal acceptance, there will always be a majority that is either positive or negative towards GMOs. These scenarios describe extremes and they are no predictions of the future. The worlds described are the extremes of the axes 'external pressure' and 'societal acceptance' and they offer a framework for identifying relevant policy questions in the various situations.



Figure 1: Four scenarios for GMOs in European agriculture based on the drivers 'societal acceptance' and 'external pressure'. Scenario 1 is titled 'GMOs for Luxury'. In this scenario there is a high societal acceptance, while there is no external pressure to cultivate GM crops. In scenario 2, 'Global Motivation', there is also a high societal acceptance, and there is also external pressure. Societal acceptance in scenario 3 is low and an external pressure to cultivate GM crops is lacking; this scenario is titled 'European Character'. Lastly, a scenario titled 'Costly Ideals' is sketched, in which there is external pressure, while there is little societal acceptance of GMOs.



# 2. Scenario 1: GMOs for Luxury

In the scenario GMOs for Luxury, there is no external pressure for the cultivation of GMOs in Europe, and societal acceptance is high. The EU is in concordance with the rest of the world on GMOs, and the WTO rules and the Cartagena Protocol set the tone. GMOs can be cultivated when they are deemed safe for people and the environment. Enough food is produced both for the population of Europe and for the rest of the world. Even with a growing world population, an increased agricultural yield meets the increased demand for food. The application of modern agricultural techniques and the use of artificial fertilizers and pesticides in developing countries contribute to this. Moreover, the market sees GM crops that are resistant to diseases and plagues. Europe profits from an increase in the agricultural production of former Soviet states as a result of greater harvests and an expansion of agricultural acreage.

Europe is not self-sufficient, and just like in the current situation, it is dependent on import from the rest of the world. GMOs are imported or produced whenever it offers benefits for producers or consumers.

The crop improvement market and business are focused on new products as well as profit-raising characteristics. Crops are developed that taste better, have a better constitution and look better, and so have a direct benefit to the consumer. A new, consumer-focused market with innovative products is being tapped. Because plenty of food is being produced, the biomass sector gets an opportunity to grow.

## 2.1 Innovative products increase consumers' freedom of choice

In the scenario 'GMOs for Luxury', societal acceptance is high. It is possible that through applying GMOs in a number of luxury products, a change took place in the acceptance of GMOs. Through a small niche market of GM products with a high added value, a transition took place that also reached agriculture on the whole. External pressure stays out and enough food is being produced to feed a (growing) world population. Citizens and consumers have accepted GMOs as a part of the product selection in supermarkets. Whenever it is beneficial to either producers or consumers, GMOs will appear on the market. Higher yields or a decrease in the number of pesticides needed will create more profit for producers. Products with health benefits and producers the profits. Supermarkets offer a wide range of choice for both GMO products as well as conventional products, which carry all sorts of labels for health, sustainability and animal-friendliness.

Through a lack of external pressure and hardly any societal resistance, the market finds space for GMOs that are used for other purposes than food, such as luxury products. Companies focus on GM flowers, plants and works of art. Unique flowers and works made from organic materials can be custom-ordered, serving an exclusive market.

GMOs are assessed on safety before they enter the market. Once deemed safe, these products are made exempt from further rules and are classed under the common selection of food and products. A number of GM products fall under luxury products, meaning a certain margin for possible risks is accepted, such as is the case with alcohol and tobacco.

The broad public attaches little value to labelling, where the presence or absence of GMOs is indicated. The indication of GMOs is solely used in combination with specific claims for health and sustainability. The public debate on the risks of GM products is no longer held actively, and consumers are convinced by the advantages that specific GM products offer. Debate takes place on these advantages, instead.

Debate is focused the validation of claims on (GM) foods, such as a certain health benefits. Sustainability claims about companies that develop products for the agricultural sector also spark debate. The media focus on these subjects, too. Articles in newspapers cover the development of new products and gadgets and the validation of claims about existing products. Consumers' opinions play an important part in this. The fact that societal acceptance is high in this scenario does not mean that everyone accepts GMOs. A minority of the European population will accept GMOs less or not at all. Some NGOs become less critical towards GMOs because former objections concerning safety have been lifted or they changed their risk perception. They mostly focus on bending the 'GMO developments' to their own ends, such as food distribution across the world and driving back environmental pressure. A small minority will continue to be principally against GMOs. This group holds active debates to convince people that GMOs in the current situation are not necessary and moreover unnatural. However, this is limited to communicative means because radical actions do not invoke sympathy in a population that has already accepted GMOs as a part of the food supply. A niche market emerges, focused on these consumers, offering GMO-free products that are grown by smaller businesses or in private vegetable gardens. Consumers pay high prices for these (imported) products, because the costs for chain certification to guarantee GMO-free products increase along with the increasing acreage of GM crops.

### 2.2 Businesses are focused on consumer advantage GM crops

Crop improvement businesses are focused on new products with a direct advantage to consumers, next to profit-raising characteristics (to the advantage of producers). A high societal acceptance and a lack of external pressure create room in the European market for the development of a broad range of products. One can speak of a small segmented market for products with a high added value. GMOs that are potentially profitable (or cost-cutting) stand a good chance in the market. Hence the market provides pressure to innovate.

Dutch businesses mainly innovate in the consumer market, where sustainability is an important element, among other things. Moreover, pharma crops, ornamental plants, and *functional foods* are being cultivated. The Dutch crop improvement sector is making ample use of GM techniques and focuses mostly on the development of new flowers and plants for the consumer market. The fruit and vegetable sector, too, develops new products that do not only appear in the Netherlands, but also abroad. In this scenario, the Dutch agrofood and crop improvement sectors see good opportunities for developing fruits and vegetables with new characteristics, both in the Netherlands as well as in Europe and in the rest of the world. Because sufficient amounts of food are being produced, a sector that focuses on the production of biomass will get an opportunity for steep growth. Crops are not only grown for the food supply, but they are also used in chemistry and for biofuels. The Netherlands will mostly focus on smaller niche products and not on the production of biofuels, considering its relatively small amount of farmland.

Because of the space that was created on the European market where previously hardly any GMOs were cultivated, fierce competition between businesses unfolds. Businesses discuss take-overs and patents among themselves. As the market opens up and an increasing amount of competition ensues, debates take place on intellectual property rights (IPR). Businesses that want to protect their products or develop new products can't do without specialists in this field.

### 2.3 Science as a source for new innovations and talent

Scientific input is indispensable for innovation at R&D departments in corporations. Scientific research into new genes, characteristics and metabolic routes is at full capacity in the Netherlands and Europe. Companies are keen on following these developments with the purpose of utilizing them for new innovative products. Student competitions for biotechnological gadgets also form a source for localizing new talent and discovering new uses. Dutch scientists and research institutes are subsidized by the government, but also by corporations. Talented people come from afar to work on biotechnological innovations. Science is on good terms with the corporate world, so new innovations are quickly implemented.

### 2.4 Government validates claims of new products

The EU is in concordance with the rest of the world on GMOs. The WTO rules set the tone for this: GMOs can be cultivated if they are deemed safe for people and the environment. It remains a government task to judge products on these points before they enter the market. However, the role of the government is limited in comparison to the current situation, as there are no labelling issues and there is an agreement on the safety rules.

Moreover, the government plays a role with the assessment of other aspects, such as health and sustainability claims. These tasks are partially outsourced to scientific advisory committees. Consumer organizations also keep themselves occupied with the validation of claims of new products, both GMO as non-GMO, and supply them with a certification mark. The question remains whether or not the government should regulate the line of certification marks so as to avoid that consumers are overwhelmed by too many quality marks.

# 2.5 Conditions for the scenario GMOs for Luxury and challenges for government policy

The realization of this scenario is particularly made possible through a worldwide application of modern agricultural methods, where global food production keeps pace with an increasing demand through the use of new, technological developments and scientific insights, and through the opening up of new farmland. Moreover, based on genetic modification techniques that are becoming more and more fine-tuned, a broad range of products is being developed with characteristics that appeal to consumers and producers in new and specific ways, also in Europe. This scenario is valid as long as global food production can keep up with an increasing demand for food and there are no repeated failed harvests due to climate change. Food security can come under pressure when there is a growing competition with biomass production. Biomass production can directly compete with food/feed applications and indirectly compete with hectares of farmland. Moreover, consumers' trust in the safety of GMOs is important with regard to the tenability of this scenario. Incidents in which GMOs are placed in a negative light can quickly undermine societal acceptance.

For the (European) government, this scenario holds the task to safeguard food security while biomass production is growing, and to enable a trustworthy system for the safety assessment of new GM products. Moreover, the government faces the question of how the use of specific product certification marks geared to consumer preferences can be regulated. Another question the government must deal with is whether and how protection can be offered to a small group of principled opponents of GM food by creating a market for GMO-free products based on a system of chain certification.

## Choices & policy questions in the scenario 'GMOs for Luxury'

In the scenario 'GMOs for Luxury', the following choices and policy questions will start to play an important part, among others:

#### Stimulating biomass production or investing in food production?

- Is food security sufficiently safeguarded, also for the future?
- Is food production geared to/able to cope with possible incidents?
- Should biomass be imported or produced locally?
- What are the pros and cons of importing biomass?
- When prioritizing biomass production, can one still switch back to food production in the case of incidents (food production under pressure)?

#### Continuing or abolishing the labelling GM products?

- For whom is freedom of choice in the field of GMOs important?
- Can and should the government continue to guarantee freedom of choice concerning GMO-free products?
- Is this a government task?
- Who will pay for this? Consumers themselves, or the government?

### Regulating certification marks a task for the government or the private sector?

- Next to safety assessment, should the government play a role in the regulation of certification marks and the supervision of, for example, health claims on products?
- Who may issue certification marks (companies, chains, consumer organizations)?
- Which other organizations are fit for supervising the regulation of certification marks?
- What are the risks when the trust of consumers or citizens is impaired in the case of incidents with these certification marks?
- Should the government play a supportive role (for example through government campaigns) by providing information on certification marks?



# 3. Scenario 2: Global Motivation

In the scenario 'Global Motivation', there is both external pressure to cultivate and import GM crops as well as a high societal acceptance. The EU is in concordance with the rest of the world on GMOs, where WTO rules set the tone. GMOs can be cultivated when they are deemed safe for people and the environment. The admission procedures for GMOs are minimalized whenever possible to gain time, as insufficient food is being produced to feed the world population, and haste must be made with commercializing new crops that contribute to a solution. The prices of food in the Netherlands and Europe are high, and supermarkets must deal with temporary shortages of certain agricultural products.

Food production must increase worldwide and all possible means are employed to this end, including genetic modification. Moreover, attempts are made to improve the efficiency of agricultural production in developing countries through the employment of modern agricultural techniques and the use of artificial fertilizer and pesticides. More land is being used for agricultural purposes worldwide. Where needed, nature reserves are used to this end.

Scientific research and the crop improvement branch are focused on raising the production and stress tolerance (droughts, salt and flooding) of agricultural crops. Both science and corporations receive extensive (financial) support from the government. The connection between science and business is very efficient for the purpose of quickly putting new crops onto the market.

Consumers see genetic modification as an important partial solution for the global problems concerning the food supply. GM products are found in shops everywhere. Consumers consider the labelling of GM products of secondary importance in a time where variety in food is scarce.

## 3.1 Consumers put aside choosiness for global problems

Societal acceptance is high in the scenario 'Global Motivation'. This acceptance is partially enforced by the external and moral pressure that is caused by global problems. Consumers see genetic modification as an important partial solution for global problems concerning the food supply. That most GM products do not offer added benefits (taste, looks) is not an issue for consumers. It's not the time to be choosy. In this situation, many consumers consider the 'naturalness' of food secondary to food security. Products that are derived from GM plants, as well as whole foods such as fruits and vegetables, can be found in shops in abundance. Consumers consider the labelling of GM products secondary in a time where variety in food is scarce. Once GM products enter the market, they are sold mixed with conventional products. Eco shops that offer GMO-free products have mostly disappeared from the market, due to high prices and the disinterest of consumers. Normal products are expensive enough to many consumers. Next to the insufficient food production, the purchasing power of the EU has decreased due to a shift of the economic centre from the West to Asia.

The offer of vegetarian products increases and is promoted through the media by the government, consumer organizations and NGOs that plead for a change in diet that requires less input. The price of meat in supermarkets is high, among other things because of a rise in the cost of cattle feed.

Avoiding hunger and preserving food security are important themes in public debate. Monopolies that push up prices are criticized by consumer organizations and other organized interest groups, as they consider monopolization an impediment to quick innovation on behalf of food production. By pointing businesses to their social responsibilities, new technologies are made available. Other prominent subjects in debate are the costs of rules and chances for the entrepreneurs' organization (MKB).

The minority of NGOs that does not accept GMOs is divided. A part of them continues to resist the use of GMOs in food production. As organic agriculture without GMOs is slowly being eradicated, radicalization seems imminent for this small group of NGOs. Other NGOs remain of the opinion that GMOs are not a complete solution for the problems, but they do accept that they can contribute to food production. These NGOs are focused mainly on a fair distribution of the available food, and on raising the yields in developing countries through more efficient agricultural techniques.

The NGOs mostly employ communicative means in order to position themselves. Destroying field trials with GM crops and preventing other experiments is altogether unthinkable and will not receive any support or sympathy from consumers. Demonstrations take place, for example at Rotter-

dam harbour, where resources for cattle feed are imported. NGOs are of the opinion that the Western world must curb meat consumption as long as food production is insufficient.

The media are aware that there is pressure to produce more food. They focus mostly on the potential of new developments to contribute to a solution to the problem. In the media, pleas are made for, among other things, a change in diet through less meat consumption, so effectively, more food will be available to the world population.

### 3.2 Businesses give their all for food security

GM crops are being cultivated worldwide, also in Europe and the Netherlands. The European market in in the field of GMOs is picking up, but it lags behind the rest of the world. Companies outside of Europe that have already been putting GMOs on the market for a long time, expand on their head start. The Netherlands plays an important role as a source of knowledge, and the crop improvement sector provides new plant varieties that are produced in other countries. Of the crops that are produced in the Netherlands, maize, potatoes, beets, wheat have GM varieties available that are resistant to plagues, diseases and tolerant to herbicides. The Netherlands functions as an important transit port for conventional and GM products as a resource for cattle feed such as soy. Through food shortages, the price of cattle feed rises, and thereby the price of meat. Hence there is a growing market for meat substitutes. The government subsidizes companies that innovate in the field of meat substitutes in the hope that better products will be developed, so well-to-do consumers are stimulated to eat less meat. At the request of companies and the government, advertising agencies put a lot of effort into boosting the image of vegetarian products.

Pollution and climate change are global problems, next to food shortages. However, the market for biofuels has stagnated because the food supply has the highest priority. On a small scale people are still working on environmentally friendly fuels that limit the emission of greenhouse gasses. Here, too, NGOs demonstrate against the use of biomass for ends other than food. Focus in the energy and fuel sector shifts to the development of electrical vehicles. It is expected that the market for biofuels will pick up when food supply problems subside.

### 3.3 Science and business join forces

Considering its knowledge in the field of agricultural systems, the Netherlands is a leading source for knowledge where it concerns the development of new GM crops. Scientific research into GMOs

flourishes and there is an efficient connection with corporations, so new products quickly enter the market in the Netherlands and abroad.

The GMOs that are being developed are mostly designed to increase harvests and food security, and not for direct consumer benefits. However, because of food shortages mostly in developing countries, food efficiency is a growing problem. This is why crops are also being developed that compensate for vitamin and mineral deficiencies due to unvaried diets. Moreover, research in Western countries is focused on the development of good meat substitutes.

### 3.4 Government protects safety and food security

Europe cannot withdraw from global developments and problems, because it is not self-sufficient and strongly dependent on the import of agricultural products from the rest of the world. Food prices rise because of shortages, and the import of resources for cattle feed meets the resistance of a part of the population.

The EU is in concordance with the rest of the world on GMOs. The WTO rules set the tone: GMOs can be cultivated if they are deemed safe for people and the environment. The admission procedure for GM crops is minimalized to the most urgent safety aspects, in order to save time and expenses and put GM crops on the market as soon as possible. The MKB receives subsidies for this process. The MKB and sector organizations put the government under pressure to do something about market regulation and to curb the monopolization of some large multinationals in the field of GMOs. The government is challenged to find a balance between the production security that large corporations offer and the dependency and, as the case may be, monopoly that is thereby created.

International discussions take place on the possibilities for import and export quotas, with the goal of creating a better distribution of food across the world. These negotiations progress with difficulty. An increasing tension may cause polarization between various parties and countries. Through dissatisfaction about the current situation and rising food prices, anti-globalization parties that focus on Europe itself can easily gain in popularity.

The government supports consumer organizations that promote a decrease in meat consumption. Subsidies for meat substitutes are not needed, because the price of meat has already increased drastically due to the rising prices of cattle feed.

# 3.5 Conditions for the scenario 'Global Motivation' and challenges to government policy

Conditions under which this scenario could take place are: the stagnation of or a decrease in agricultural production through climate change, or an increase in pests and diseases, or a greatly increased demand for agricultural products due to growing prosperity in Asia and developing countries. In combination with a growing world population, this will lead to increased food shortages and rising food prices. There is heightened awareness about the necessity of a worldwide increase in food production, and consumers increasingly accept, or are indifferent towards the application of genetic modification.

The tenability of this scenario demands maximum input and optimal collaboration between science and business, focused on raising food production. In order to avoid large-scale conflicts, agreements on dealing with global problems must be achieved on the political and the international level.

An important task for the (European) government in this scenario is the stimulation of innovation that is focused on raising food production, for example, simplifying rules on the admission of GM products, without compromising food security. An important point is counteracting the monopolization of business and safeguarding the public availability of knowledge on raising agricultural productivity. The government is also increasingly confronted by the question of how it should contribute to a change in diet with measures that are focused on substituting meat production, among other things based on new GM products.

## Choices & policy questions in the scenario 'Global Motivation'

In the scenario 'Global Motivation', the following choices and policy questions will start to play an important part, among others:

#### More import or raise food production?

- Can Europe import more food? For what price and what will the consequences be when this ceases to be possible?
- (How) can food production be raised further within Europe?
- Can and should nature reserves in the Netherlands or Europe be turned into farmable land?

#### Food security or sustainable food production?

- Can a rise in food production take place sustainably?
- What does sustainable production imply for food prices?

#### More food or a change in diet?

- Should the government take measures to shrink the meat sector?
- Should the government promote a change in diet actively or passively?

#### Simplifying rules or more (financial) support to innovation?

- Can rules be eased without compromising food security?
- Should the government offer financial aid to companies attempting to put GM crops on the market?
- What are the risks when incidents do take place with regard to food security?
- Who, then, is liable?

#### Freedom of choice or food security?

• In times of food scarcity, should the government still continue to guarantee freedom of choice for a small group of principled opponents?



# 4. Scenario 3: European Character

In the scenario 'European Character', there is no external pressure to cultivate GM crops in the Netherlands or Europe. Food security is not a subject of discussion and both conventional and GM products are available worldwide. Societal resistance towards GM crops in the EU is high. Europe is not in concordance with the rest of the world on the acceptance of GMOs. While WTO rules set the tone, in practice, security requirements in Europe are much stricter than in the rest of the world. The result is that hardly any GM crops are accepted and cultivated in Europe. Europe's strict admittance policy leads to conflicts with the rest of the world.

There are no reasons for cultivating GM crops and European consumers have high resistance to GM products. This is why Europe largely closes its borders to their import. Countries that (partially) produce GMO-free products, export to Europe for higher prices. Because of increased affluence, European consumers are capable of and willing to pay higher prices for GMO-free food. Some products are no longer available GMO-free outside of Europe so they are produced locally. An extreme consequence in this scenario could be that Europe must become completely self-sufficient. If the world population continues to grow, import could become more difficult and Europe will have to make more land available for its own food production, for example through expanding farmland in Eastern Europe. For the time being, however, this is not necessary, as a sufficient amount of food is available.

The crop improvement market and business are focused on new, biotechnological techniques that do not use genetic modification. As food production is sufficient (for now), there are (small scale) opportunities for the development of a biobased economy, where emphasis lies on high-quality uses in the field of organic fine chemicals.

## 4.1 Consumers can choose from a broad GMO-free selection

Societal acceptance of GMOs is low in the scenario 'European Character'. There is no external pressure for the cultivation of GM crops and consumers do not see any benefit in the GM products that are available on the global market. Moreover, the debate continues on the consequences of GMOs for people and the environment. Consumers therefore choose to be safe rather than sorry and reject GMOs and GMO derivatives to a large extent.

No GM crops are cultivated in Europe and hardly any import of GM products takes place. Therefore, the amount of GM products that are available in supermarkets is close to none. As many imported products contain elements of GM crops, fewer products from abroad make their way to Dutch and European supermarkets. However, Europe is well capable of producing these products itself and with GMO-free ingredients. The prices of these products are higher, but their transport costs are less as they are produced locally. Through low societal acceptance, consumers are prepared to pay more for GMO-free products. Unintentional crossbreeding with GM elements from imported products is becoming a growing problem in this scenario, and the government attempts to address this.

A growing market emerges for meat and milk produced in Europe from animals that have exclusively had GMO-free cattle feed. However, a part of all livestock does not get GMO-free cattle feed. Moreover, some animal products are imported from abroad where they may have received GM cattle feed. These options offer a cheaper alternative to consumers. Public debate covers these animal products, among other things. The question is whether Europe should also prohibit the import of GM soy and meat from animals that had GM cattle feed. In the debate, consumer organizations point to differences in income that entail a limitation to consumers' freedom of choice with regard to food.

Furthermore, the debate focuses on the feasibility of this policy in the long term. When the acreage of GM crops outside of Europe continues to grow or unintentional crossbreeding takes place, import of GMO-free products will become increasingly difficult. The question is whether Europe can stay self-sufficient in future. Both the farmland in Europe as well as the costs that are involved are seen as a challenge for the future.

The debate scarcely covers the risks and safety of GMOs any longer, because they are no longer cultivated and hardly imported in Europe. Moreover, little research is done on GM crops in the Netherlands and Europe. No new insights are achieved and the debate on the risks of GMOs thereby seems to have come to a halt.

# 4.2 Businesses see opportunities for a product selection without genetic modification

No GM crops are being cultivated in the Netherlands or Europe. Crop improvement businesses move abroad or focus on techniques that do not make use of genetic modification. Companies face the challenge of innovating without GMOs, and still offer valuable alternatives for the products that are on the market outside of Europe. Biotechnology is only used to support conventional crop improvement.

The import of agricultural products still takes place, but it is mostly focused on GMO-free products. The availability of these products is slowly decreasing, hence import also decreases. Transport businesses and importers are having a hard time in the Netherlands and Europe. The Netherlands used to be one of the biggest transit ports for (GM) soy, but these activities are now being shifted to elsewhere. Apart from importers, exporters also receive blows from the new trade conflicts that result from the European import ban.

Some job opportunities may be dwindling, but new markets are also emerging. As some products can no longer be imported GMO-free, Europe must produce them locally. This creates new job opportunities and room for innovation. Young innovation businesses focus on the development of protein substitutes in cattle feed. While these substitutes are not necessary as GMO-free cattle feed can (still) be imported, there are cost and efficiency benefits if Europe becomes self-sufficient in this field, too. Moreover, it is expected that the import of GMO-free products will be harder in future.

As a sufficient amount of food is being produced in this scenario, the biobased economy gets a worldwide opportunity to grow, with a lot of emphasis on high-quality uses in Europe. If Europe must become more self-sufficient in future, a choice may have to be made between the development of biobased uses and GMO-free food.

### 4.3 EU scientists innovate with GMO-free uses

Scientific input is indispensable for innovation at R&D departments in corporations. Scientific research into new genes, characteristics and metabolic routes takes place in the Netherlands and Europe. Consequently, however, attempts are made to trigger these genes using classical plant breeding. Scientific research into GM crops takes place on a small scale in the Netherlands. This concerns mostly curiosity-driven laboratory research and some closed greenhouse experiments. Other activities have shifted to abroad, outside of Europe. Upcoming research in the field of renewable resources for chemistry is booming. For the time being, sufficient amounts of food are being produced, creating room for cultivating crops for biomass. Universities and specialized research institutes research the development of high-quality 'green' products based on a wide variety of crops, and without the use of genetic modification. Businesses have a deep interest in this, both in the agricultural and the chemical sector. Student competitions for innovations in the field of (sustainable) biotechnology form a source for the recruitment of new talent and the discovery of new uses. Dutch researchers and research institutes are subsidized by the government, and also by corporations.

### 4.4 Government expands possibilities for self-sufficiency

European law is strict and bureaucratic. The EU sees an increase in trade conflicts with the rest of the world because it does not keep to the WTO agreements. Because the market outside of the EU is large enough, however, these conflicts do not get out of hand.

The Dutch government is occupied curbing food prices and stopping unintentional crossbreeding with GM crops with respect to freedom of choice. The government strictly monitors imported products for the presence of GMOs, and invests substantially in fine-tuning and actualizing detection methods for GM products. A growing GM acreage outside of Europe with a continued selection of new products poses a problem to and constantly demands the attention of a government that has a zero-tolerance policy towards crossbreeding with GMOs. The chain certification of GMO-free products is a costly procedure. The government must decide to what extent these costs can be passed on to consumers without putting pressure on poorer people's freedom of choice. Furthermore, the government must think about long-term policy. The most important issue is how the Netherlands and Europe can remain self-sufficient when fewer products are imported GMO-free and must thus be produced locally. When import becomes more difficult, the government must make a choice between biomass production and food. The government performs studies on alternatives for food resources and seeks out places for new farmland.

## 4.5 Conditions for the scenario 'European Character' and government challenges

The most important conditions for this scenario are that Europe must become increasingly self-sufficient in the production of GMO-free food and that opportunities continue to exist for the import of GMO-free products from countries outside of Europe. One can speak of a heightened prosperity within Europe, where consumers increasingly choose for a growing selection of relatively expensive, but 'natural', traditional, local products.

This scenario is only tenable as long as GMO-free import from countries outside of Europe remains possible (on a modest scale), and as long as Europe can become more self-sufficient through the application of smart, innovative, GMO-free methods for food production and/or through the expansion of existing farmland. Growing dissatisfaction among poorer consumers concerning high food prices could provide a turning point in the societal acceptance of GMOs in this scenario.

In this scenario, the (European) government has the task to stimulate self-sufficiency in the field of GMO-free food production, and to safeguard the import of GMO-free products through agreements with countries outside of Europe. The government's targets are not only focused on food security, but especially also on curbing food prices. Next to safeguarding the import of GMO-free products, chain certification and monitoring are also important tasks for the government. Finally, the government is posed with the question to what extent the pursuit of European self-sufficiency is compatible with ambitions in the field of biomass production.

# Choices & policy questions in the scenario 'European Character'

In the scenario 'European Character', the following choices and policy questions will start to play an important part, among others:

#### Import or self-sufficiency?

- Can the Netherlands/Europe still import GMO-free, and at what costs?
- When (at what price increase) should Europe switch to self-sufficiency?
- How can food production within Europe be increased further?
- Can and should nature reserves in the Netherlands/Europe be utilized for food production?
- To what extent can Europe become self-sufficient with regard to agriculture and at what costs?

#### Freedom of choice or food security?

- Should the government take measures to shrink the meat sector?
- Should the government promote a change in diet, actively or passively?
- Can and should the government promote acceptance of GMOs, actively or passively?
- How can freedom of choice be safeguarded for the less well-to-do?
- Can the Netherlands and/or Europe isolate itself from the rest of the world?



# **5. Scenario 4: Costly Ideals**

In the scenario 'Costly Ideals', there is external pressure to cultivate GMOs, while societal acceptance is very low. The world food production is insufficient and solutions must be found quickly. The EU is not in concordance with the rest of the world on the acceptance of GMOs and it has mostly closed its borders to these products. While the WTO rules set the tone, in practice, the safety requirements in Europe are much stricter than in the rest of the world. The result is that in Europe, no GM crops are admitted or harvested. The strict admittance policy in Europe leads to conflicts with the rest of the world, which is already dealing with food shortages. Europe cannot withdraw from these developments, as it is not self-sufficient and strongly dependent on the import of agricultural products from the rest of the world. The Dutch and European governments are divided, as on the one side the food security is at stake, and on the other side, consumers are strongly opposed.

There is insufficient food production in the Netherlands, Europe and the rest of the world. GMOs are cultivated worldwide, with the exception of Europe. The EU is trying to be as self-sufficient as possible, as GMO-free products are hardly available on the global market. Dutch businesses are trying to search for solutions to the problems without genetic modification. However, the limits of self-sufficiency in European agriculture appear to have been reached. All available farmland in Europe and the Netherlands is already in use and production is already optimized. Land that is not yet in use as farmland is unsuitable because of droughts, flooding or salinization. Nature reserves have been marginalized and livestock have been brought to a minimum so as to have more acreage available for food production. Total livestock is decreasing further because GMO-free components for cattle feed are difficult to come by through import. Companies are focused, among other things, on the development of meat substitutes, so as to conform to the wishes of consumers.

## 5.1 Majority of consumers can no longer choose

In the scenario 'Costly Ideals', societal resistance to GM crops is high, despite external pressure to produce more food. For the majority of the European population, the (perceived) risks and unnaturalness of GM products are more serious than problems such as food shortages and high food prices. The years in which GMO-free products were easily obtainable and Europe was becoming more self-sufficient have only strengthened these feelings. The role of large, globally operating corporations in the development of GM crops also contributes to the continuance of societal resistance to GMOs in Europe.

Products in supermarkets are mostly GMO-free, although unintentional crossbreeding with GMOs from abroad is becoming increasingly difficult to avoid. The number of incidents where batches of GMO-free products do turn out to contain GMOs is increasing. GM products can hardly be found in European supermarkets, but they do seep in via smaller markets and shops to provide consumers with a cheaper alternative. The prices of normal products are high and for a growing number of consumers difficult to produce. This leads to dissatisfaction and debate unfolds on freedom of choice for the less well-to-do.

All available farmland in Europe and in the Netherlands is used and optimized to provide GMO-free agricultural products. Nature reserves are used to this end in the Netherlands and Europe whenever possible. While the majority of European citizens is against GMOs, some people do begin to doubt the value of preserving nature reserves versus preserving a GMO-free food chain. They plead for alternative options for solving the problems, such as a continued decrease of meat consumption. The drive for a decrease in meat consumption is not only supported by arguments on the worldwide food problem, but aspects such as sustainability and animal welfare are also emphasized.

Interest groups spring up in the Netherlands and Europe that are dissatisfied with the current situation in which GMOs are barred. They plead for the import of GMOs for the interest of the less wellto-do. In public debate, new arguments are presented such as rising food prices and sustainability, in the hope to decrease societal resistance to GMOs. Moreover, proponents of GMOs point to the dire situation and warn that consumers can no longer be choosy. NGOs and companies outside of Europe, too, mix themselves in the European debate and try to convince national governments of the global problem that must be tackled cooperatively.

## 5.2 Businesses see self-sufficiency limits draw closer

GMOs are cultivated worldwide, with the exception of Europe. The Netherlands and Europe attempt to import GMO-free or be self-sufficient. Because of global food shortages, priorities in the rest of the world are not with a strict chain division, causing GMO-free import to be more difficult and thereby decrease. Through this decrease, Dutch importers and transhipment companies are struck hard.

Dutch corporations are trying to search for solutions to the problems without genetic modification. There is hardly any room for the development of a biobased economy. In this field one can only speak of innovations focused on making production processes more efficient through biomass by utilizing leftover materials to the maximum. The question is whether the limits of innovation possibilities are being reached now Europe must rely on self-sufficiency for GMO-free products. Especially the time that is needed for developing new crops with classical plant breeding is a bottleneck. Branch organizations for the Dutch and European biotechnology sector point out this problem to the government. They see a partial solution in the application of techniques that use genetic modification, but where the end product does not contain genetic modification any longer. They lobby for the government to consider these products as GMO-free. Other businesses move abroad.

Tropical fruits and fruits and vegetables that are only sometimes in season are cultivated in greenhouses in warmer European regions. The cultivation of fruits and vegetables that used to take place in the Netherlands in season, now takes place in greenhouses in order to ensure year-round production. As many meat products are becoming increasingly expensive, companies focus on the development of good meat substitutes to meet the wishes of consumers.

There is hardly a market for biofuels from crops as the food supply has the highest priority. Focus in the energy and fuel sector shifts to the development of electric vehicles. Small-scale work is performed on environmentally friendly fuels that limit the emission of greenhouse gasses. It is expected that the market for biofuels will pick up when food problems have mostly been tackled.

### 5.3 Science pushes policy limits

The speed of innovation of new crops that have been produced without genetic modification seems to lose out to the pressure and urgency of the world food problem. This can also be perceived in scientific research. While some alternatives have been developed for GM crops such as soy, they turn out to be insufficient for the problems in Europe and in the rest of the world. Scientific research tries to push the limits of current policy, and it aims to develop new techniques with the help of

genetic modification, where simply the end products do not contain GMOs. In this field, intensive collaboration takes place between research institutes and corporations, which have a great interest in these developments. Fierce debates are taking place with regard to permits for research institutes and corporations that want to perform experiments with these products outside of laboratories and greenhouses.

### 5.4 Government divided between food security and freedom of choice

Conflicts have arisen between the EU and other trade blocs, as the EU does not want to import GM products and places strict demands on GMO-free products. These trade conflicts do not only have consequences for import; they also affect the export of European products. Some countries take advantage of the conflicts by continuing to offer GMO-free products, despite worldwide food shortages, and they do good business. International organizations and governments up the pressure towards Europe to tackle global problems cooperatively. They attempt to convince Europe to allow the import of GMOs after all and to contribute to innovation in this field.

The EU has long accepted rising prices for GMO-free products, and whenever possible regulated them, but the limits increasingly appear to be reached. The government must deal with dissatisfied consumers and organized interest groups that lobby against high food prices but simultaneously do not want GMOs. Through campaigns stimulating a change in diet and subsidies to specific groups, the government tries to meet the wishes of these consumer organizations. These measures appear to offer only temporary solutions.

Public debate is dominated by exaggerated claims on both the risks of GMOs that are brought forward by European NGOs, as well as on the positive effects of GMOs that are brought forward by NGOs and businesses abroad. The government tries to relativize the situation and objectify the information available. Next to this mitigating policy, it tries to identify who is making which claims in the debate, to create more clarity on the debate's objectivity for consumers.

Dutch politics is divided between parties that plead for streamlining the GMO policy with the rest of the world, and parties that plead for continuing to optimize agricultural production to become self-sufficient in GMO-free production.

Illegal import of GM products grows hand over fist because it can yield high profits, especially as these products are not labelled as GMOs. There is little monitoring of illegal import and the sale of GM food products, due to high costs and because many modifications are unknown or impos-

sible to distinguish from conventionally crossbred characteristics. The government hereby loses credibility.

# 5.5 Conditions for the scenario 'Costly Ideals' and challenges to government policy

The conditions under which this scenario could take place are the same as in the scenario 'Global Motivation', with regard to external pressure. Through climate change, repeated bad harvests, and increased crop damage as a result of diseases and plagues, global agricultural production stagnates, leading to increased food shortages and a rise in prices. The demand for agricultural products increases, due to a growing world population and increased prosperity in countries in Asia, for example. Despite the increased tension on the global food market, societal resistance against genetically modified organisms remains high in Europe. At the same time, there is increased unrest among consumers concerning the strong rise in food prices.

Considering these tensions, this scenario is the least tenable of all four worlds that are sketched in this report. Only if Europe's borders are closed completely, if it becomes self-sufficient in the field of agriculture, and if there is a radical change in diet, will there be a way out in the long term. In this scenario, the (European) government will have to make compromises and seek out the extreme limits of possibility. For the sake of food security, the government must create space for innovation to raise food production. For example by actively supporting research that makes inventive use of genetic techniques, without it being a matter of GMOs, and by putting more emphasis on the assessment of the final product with regard to the rules on GMOs. The government is also posed with the question to what extent the consumption of meat can actively be discouraged through the use of tax measures. There will be very little room for the development of a biobased economy in government policy.

## Choices & policy questions in the scenario 'Costly Ideals'

In the scenario 'Costly Ideals', the following choices and policy questions will play an important part, among others:

#### Import or self-sufficiency?

- Can the Netherlands/Europe still import GMO-free, and at what costs?
- How can food production within Europe continue to grow?
- Can and should nature reserves in the Netherlands/Europe be used for the production of food?
- To what extent can Europe become self-sufficient with regard to agriculture, and at what costs?
- To what extent is the Netherlands and/or Europe responsible for food security in other countries?

#### GMO or not?

- Which techniques are classified under the GMO rules and which ones are not?
- What are the limits of the GMO rules?
- How can innovation be stimulated without producing new GMOs?

#### Freedom of choice or food security?

- Can and should the government promote the acceptance of GMOs, actively or passively?
- How can the government take measures to shrink the meat sector?
- How can the government promote a change in diet?
- How can freedom of choice be safeguarded for the less well-to-do?
- Can the Netherlands and/or Europe isolate itself from the rest of the world?

# 6. Conclusion and Discussion

It is expected that the amount of GM crops and agricultural products on the global market will continue to rise in the coming years. The acreage of GM crops outside of Europe is growing steadily.<sup>10</sup> Within Europe, however, hardly any GM crops are being cultivated. One of the causes for this is that public opinion is strongly opposed to GM crops.

The debate surrounding the application of GM crops is concentrated, next to safety, on individual freedom of choice and global problems with regard to population growth, food production and climate change. Global developments in agriculture raise the question of which position Europe will take with regard to separate member states and with regard to the rest of the world. And derived from this, what developments may take place in the Netherlands?

## 6.1 Four scenarios for GMOs in agriculture

In this report, four scenarios have been elaborated that help to identify the current situation's key uncertainties surrounding GMOs in Europe. Based on the drivers 'societal acceptance' and 'external pressure', four worlds have been sketched with reference to GMOs in Europe. Both drivers are both uncertain as well as influential with regard to future developments in agriculture.

## Summary of the scenarios

#### GMOs for Luxury

There is no external pressure for the cultivation of GMOs in Europe and societal acceptance is high. Through the application of GMOs in a number of luxury products, a turning point took place in the acceptance of GMOs. Through a small, segmented niche market of GM products with a high added value, a transition took place that also managed to reach agriculture on the whole. Consumers can choose both GMO products and GMO-free products, in combination with a whole range of certification marks with regard to health and sustainability claims. Business is focused on a new consumer market with innovative products. Food safety is an important condition for the (permanent) acceptance of these products. Because enough food is being produced, the biobased economy has ample room for growth.

#### Global Motivation

In the scenario 'Global Motivation', there is both external pressure to cultivate and import GM crops as well as a high societal acceptance. Food production must increase worldwide, and all possible means are brought into action to this end, including genetic modification. Consumers see genetic modification as an important partial solution to solving global problems with the food supply. GM products can be found in the shops in abundance and labelling is secondary. Food prices in the Netherlands and Europe are high and supermarkets must cope with temporary shortages of specific agricultural products. International discussions on a better distribution of food across the world play an important role in this scenario. Through dissatisfaction about the current situation and rising food prices, anti-globalization parties that focus on Europe itself can easily gain in popularity.

#### European Character

There is no external pressure to cultivate GM crops in the Netherlands or Europe in the scenario 'European Character'. Partially because societal resistance to GM crops is high, Europe is largely closing its borders to import. This leads to trade conflicts that affect both importers and exporters in Europe. Countries that produce (partially) GMO-free deliver to Europe for higher prices, and they do good business. Some products are no longer available GMO-free outside of Europe and are thus produced locally. Even without applying genetic modification, innovations are made in the fields of crops, biofuels and other types of sustainable energy. The most important question for the government in this scenario is to what extent they can be self-sufficient in the future with regard to agricultural products, and at what cost.

#### Costly Ideals

There is external pressure to cultivate GMOs in the scenario 'Costly Ideals', while societal acceptance is very low. The Dutch and European governments are divided between on the one hand food security, and on the other the strong objections of consumers. The limits to the self-sufficiency of European agriculture appear to have been reached. The strict admittance policy and the ban on the European import of GMOs lead to conflicts with the rest of the world, which is already dealing with food shortages. Normal products are expensive and for a large part of consumers no longer affordable. The government is under great pressure to make choices. The question is to what extent Europe can isolate itself from the rest of the world, and how it can guarantee food for its population at a reasonable price.

## 6.2 Expectations of future unjustly overshadow other scenarios

The scenarios contain a number of recognizable aspects that, to some extent, can be reduced to elements that play a role in the current situation regarding GMOs in European agriculture. The

question of which scenario most corresponds to the current situation will probably lead to various answers. These answers will probably diverge even more than answers concerning the desirability of the various scenarios.

With regard to international literature from the past year on agriculture, the predominant view is that scenario 2 (Global Motivation) will ultimately (have to) prevail.<sup>11,12,13,14</sup> At least, this is true for the driver 'external pressure'. Opinions vary on the increase or decrease of the societal acceptance of GMOs. The general tenor of many reports that appeared in the media recently is that a situation will unfold in which the world population continues to grow and consume more animal products, causing a need for a strong increase in food production. Moreover, agriculture will increasingly have to deal with a changed climate and its consequences for food production. Moreover, a number of reports emphasize that genetic modification is indispensable as a partial solution for feeding the world population. This future scenario is portrayed as unavoidable and governments are called upon to act accordingly. Other possible options that may seem less likely at the moment are hereby overshadowed.

There is a danger that tunnel vision makes people focus on but a single scenario. In complex situations where many different factors (and actors) take part, it is important to think out of the box, so as to be prepared for various scenarios. Policies must be developed not only for the most probable or expected situation; one must also prepare for unexpected turns. In the elaboration of the scenarios in chapters two to five, each situation corresponds with a number of specific policy challenges. This chapter will cover the most important common themes and policy questions for the four scenarios. This regards issues that are important to the government regardless of the development of the drivers 'external pressure' and 'societal acceptance'.

## 6.3 Dynamics of scenarios shed light on choices

The scenarios show what choices and policy questions arise when the societal acceptance of GMOs or external pressure changes. These choices are characteristic to each scenario and offer a framework for speculating what kinds of reactions might take place to unexpected turns in European and worldwide agriculture. They also enable debate on the desirability of the various future scenarios. Furthermore, they offer a perspective on the consequences that the cultivation and import (or lack thereof) of GMOs can have for agriculture, science and business, and also for consumers in the Netherlands and Europe. The scenarios sketched are merely snapshots of fictitious worlds based on the chosen drivers. It is expected that given some time, none of these scenarios will become stable, but rather continue on to new phases with specific challenges and choices. 6.3.1 Core themes for the future of GMOs in European agriculture

The four scenarios are both similar and different from each other. With a low acceptance (scenarios 'European Character' and 'Costly Ideals'), genetic modification is an exception to the rule with regard to other biotechnical developments. GMOs are subject to specific laws and rules, and consumers, too, consider GM products to be a category apart. In 'GMOs for Luxury' and 'Global Motivation', genetic modification is but one of the options for new developments in the field of food and resources. The recognisability of GMOs does play a role in 'GMOs for Luxury', but especially in combination with other product-specific claims.

The role and nature of biotechnological applications, too, differs between the scenarios. In 'GMOs for Luxury', biotechnology is focused on, among other things, new innovative applications that are not useful per se but rather fun or pleasurable. In the scenarios 'Global Motivation' and 'Costly Ideals', where external pressure is high, there is little attention for consumer-focused products, and investments are mostly made in the production of sufficient amounts of food.

The themes 'freedom of choice' and 'food security' play a role in virtually each of the scenarios. 'Freedom of choice' with regard to GMOs is mostly applicable when societal pressure is low. The core theme 'food security' is especially in the foreground when external pressure increases. The themes 'freedom of choice' and 'food security' seem to be at conflict in the scenarios, with the exception of the scenario 'GMOs for Luxury'. This poses the government with the challenge to find the right balance and, where possible, safeguard both aspects.

#### 6.3.2 Choices on innovation, security and sustainability influence food security

The scenarios brought forward the following themes with regard to food security:

- Innovation policy (diversity)
- Safety assessment new products
- International agreement on sustainability & distribution of food

In order to safeguard food security now and in future, innovation in the field of food production is essential. At this moment, the development of new crops that can better resist drought, flooding and salinization are important items on the agenda. Diversity in innovation policy, too, is important. Through the continued research and development of possibilities for various types of agriculture and crop improvement, multiple solutions are available with an increase of external pressure. The safety assessment of new crops and products is a second item on the agenda for safeguarding food security in the long term. An incident with a GM crop or product that damages people or the environment can be a threat to food security, and moreover, negatively influence public opinion. Sustainable agriculture is essential under circumstances of increased pressure, meaning an increased production must be achieved, also in the long term. Agreements on this must be made on the international level. This also applies to the distribution of food. When external pressure increases, especially western countries play an important, if not crucial role in the making of decisions on the distribution of food and the import and export routes across the world.

With an increase of external pressure, the government may be posed with the following policy questions, which could demand different answers, dependent on the specific situation and urgency:

- How can food production within Europe be raised?
- To what extent can Europe become self-sufficient with regard to agriculture?
- Can and should nature reserves in the Netherlands and Europe be utilized for food production?
- To what extent are the Netherlands and Europe responsible for the food security in other countries?
- Can the Netherlands and/or the EU isolate itself from the rest of the world, and is this desirable?
- Should the government take measures to shrink the meat sector?
- Should the government promote a change in diet, actively or passively?

6.3.3 Choices on innovation, food prices and unintentional crossbreeding with GMOs influence freedom of choice

The scenarios brought forward the following themes with regard to freedom of choice:

- Innovation policy (diversity)
- Food prices
- Unintentional crossbreeding with GMOs
- Monopolization (& public support)

Preserving the diversity in innovation is not only important for food security. It is also important to the safeguarding of freedom of choice that there is continued development of various agricultural techniques. Freedom of choice does not only mean the ability to choose, but especially the ability to choose between valuable alternatives. This is true for both consumers and producers. When no more innovation takes place in the fields of crop improvement or food production, this option will become obsolete and no longer offer a sound alternative.

When prices of specific food products rise, this can become an obstruction to the freedom of choice of specific groups of society. This is not only true for consumers, but also for producers, who need starting materials and substances for crop protection for their production.

When societal acceptance of GMOs is low while freedom of choice is under pressure, the government may have to deal with various policy questions:

- Can the government continue to safeguard freedom of choice with regard to GMOs?
- How can freedom of choice be safeguarded for the less well-to-do?
- At what point is the price for GMO-free products too high?
- When (at what rise in prices or percentage of crossbreeding) should the EU switch to GM production?
- Can and should the government promote the acceptance of GMOs, passively or actively?

## **6.4 Conclusions**

The Rathenau Instituut and the COGEM have performed a scenario study into the situation of GMOs in European agriculture. These scenarios shed light on the choices and consequences involved with the cultivation and import of GM crops (or lack thereof), and offer a framework for the government to give shape to future policies. It was concluded in the last chapter that both freedom of choice and food security play key roles in all scenarios. It appears that the government is posed with the challenge of safeguarding both aspects in its policy.

The Rathenau Instituut and the COGEM point out that many recent policy and advisory reports assume a scenario in which a growing world population, a changing diet and climate change will all have a negative influence on food production. This scenario most corresponds with scenario 2, 'Global Motivation', in which there is high external pressure to raise food production. In this scenario, societal acceptance is high. In the current situation, however, there are no reasons to assume that societal acceptance in Europe, which is generally low, will become high anytime soon. However, the government is posed with the challenge of offering a solution even if societal acceptance of GMOs stays out.

The Rathenau Instituut and the COGEM point out that when the government is alert and bears in mind multiple future scenarios, it is better prepared for unexpected turns.

The scenarios in this report offer material for a thought experiment in which the consequences of various choices with regard to GMO policy are sketched. Furthermore, the scenarios can instigate the forming of new research questions and innovation policies.

# References

- 1 EFSA Press Release (2010). De Commissie kondigt voorstel aan om lidstaten zelf te laten besluiten om wel of geen ggo's te telen, en keurt vijf besluiten over ggo's goed. 2 maart 2010, IP/10/222.
- 2 http://ec.europa.eu/food/food/biotechnology/index\_en.htm.
- 3 COGEM. (2009). Sociaal-economische aspecten van ggo's. Bouwstenen voor een EU duurzaamheidsbeoordeling van genetisch gemodificeerde gewassen. Signalering CGM/090929-01.
- 4 Asselt, M.B.A. van, et al. (red.) (2010). *Uit zicht: toekomstverkennen met beleid.* Amsterdam University Press: WRR Verkenningen 24.
- 5 Gijsbers, G. et al. (2006). Biotechnologie in 2030. Vier scenario's voor de Commissie Genetische Modificatie. COGEM onderzoeksrapport CGM 2006-03.
- 6 Eurobarometer. (2006). GM Food: Europeans Still See More Risks than Benefits. European Commission.
- 7 Reformatorisch Dagblad. (2010). Boeren niet tegen gengewas. In: *Reformatorisch Dagblad*, 7 april 2010.
- 8 EU Press Release. (2010). EU and Argentina settle WTO case on Genetically Modified Organisms. 18 maart 2010. IP/10/325.
- 9 WTO. (2010). SPS Agreement Training Module: Chapter 8.1 Genetically Modified Organisms. http://www.wto.org/english/tratop\_e/sps\_e/sps\_agreement\_cbt\_e/c8s1p1\_e.htm.
- 10 ISAAA. (2010). Global Status of Commercialized Biotech/GM Crops: 2009. The first fourteen years, 1996 to 2009. Brief 41-2009. http://www.isaaa.org/resources/publications/briefs/41/executivesummary/default.asp.
- 11 EGE. (2008). Ethics of modern developments in agriculture technologies. Proceedings of the round- table debate. European Commission. Brussel: Secretariat of the EG.
- 12 The Royal Society. (2009). Reaping the Benefits. Science and the Sustainable Intensification of Global Agri culture. RS Policy Document 11/09.
- 13 IAASTD. (2009). Agriculture at a Crossroads. Island Press.
- 14 Bütschi, D. et al. (2009). *Genetically Modified Plants and Foods. Challenges and Future Issues in Europe*. Berlijn: European Parliamentary Technology Assessment.

# Appendix 1 Expert Meeting "Scenarios for GMOs in Agriculture"

#### Introduction

On 13 May 2009, together with the Rathenau Instituut the COGEM organized a workshop entitled "Scenarios for GMOs in Agriculture" at Het Buitenhuis in The Hague. The reason for the workshop was the still actual debate in the EU on the cultivation of GM crops. Partially pressured by a public opinion opposed to the cultivation of biotech crops, various EU countries block the issue of new cultivation permits. There is a search for solutions to break the impasse that has arisen within the EU. In 2009, a first initiative was made towards a proposal to include other (socioeconomic) arguments next to safety concerns in the permission procedure for GM crops.

#### Workshop

Within this framework, the COGEM and the Rathenau Instituut organized an expert meeting that was focused on finding scenarios that cover the situation's key doubts, and on showing what policy questions may arise in possible future scenarios, and as the case may be, what this entails for government policy. The expert meeting took place by means of a Group Decision Room (GDR). This is an electronic meeting setting in which, through the use of laptops, new ideas can quickly be generated, analysed and prioritized, simultaneously and anonymously. In the first session factors were identified that influence the decision on whether or not to introduce GMOs in Dutch agriculture. The two factors that scored highest on impact and the degree of doubt surrounding their development formed the axes of a graph for the four developed scenarios. Next, a second GDR session looked at which policy initiatives are relevant for each scenario.

#### Identification drivers

After extensive listing of factors that may play a part in the European discussion on GM crops, and after the first GDR session, two drivers were identified that scored highest on both impact and doubt: societal acceptance and economic pressure. Both these factors formed the axes for continued scenario development, where societal acceptance formed the X-axis and economic pressure the Y-axis.

#### Scenario development

In workgroups that took place during the workshop, first sketches of the four scenarios were made, where each scenario's most important characteristics and policy questions were identified.

#### **Expert meeting participants**

Prof. Dr. L. van Vloten-Doting (Commissie van Wijzen FES), Dr. ir. B.A. Uijtewaal (Nunhems BV), Prof. Dr. J.J.M. Dons (BioSeeds), Prof. Dr. F.W.A. Brom (Rathenau Instituut), Prof. Dr. H.G.J. Gremmen (Wageningen UR), Dr. ir. H.J. Schouten (Wageningen UR), drs. R.P. Dekker (Ministry of VROM), drs. A.F. van der Klundert (VROM council), Dr. ir. H.A. Kuiper (RIKILT), Dr. M.J.M Smulders (PRI-WUR), Prof. Dr. ir. B.C.J. Zoeteman (Tilburg University), Drs. ing. R. Mampuys (COGEM), Dr. ir. F. van der Wilk (COGEM).

Subsequently, the scenarios were fleshed out in the meetings that followed by, among others, CO-GEM members and employees of the Rathenau Instituut:

#### Meeting sub-committee Ethics & Societal Aspects (19 November 2009 and 14 January 2010)

Prof. Dr. F.W.A. Brom (Rathenau Instituut), Prof. Dr. J.J.M. Dons (BioSeeds), Prof. Dr. F.W.J. Keulartz (Wageningen UR), Prof. Dr. ir. E.T. Lammerts van Bueren (Louis Bolk Instituut/Wageningen UR), Prof. Dr. M. Margadant-Van Arcken, drs. L. van den Oever, (Netherlands Institute for Biology (NIBI)), Prof. Dr. P. Osseweijer (Kluyver Centre for Genomics of Industrial Fermentation/TU Delft), Dr. S. Roeser (3TU.Centre for Ethics and Technology/TU Delft), Prof. Dr. G.T.P. Ruivenkamp (Wageningen UR/VU University Amsterdam), Dr. J.A.A. Swart (University of Groningen), ir. H.C. de Vriend (LIS Consult), drs. T.J. Wams (Vereniging Natuurmonumenten), drs. P. van der Meer, LL.M. (present as external expert on 19 November).

#### Workgroup meeting Rathenau Instituut (30 March 2010)

Rathenau Instituut: Dr. L. Asveld, Prof. Dr. F.W.A. Brom, Dr. ir. R. van Est, Dr. ir. G. Munnichs, drs. ir. M. Riphagen, drs. J. Staman, LL.M., Dr. D. Stemerding. COGEM: drs. ing. R. Mampuys, Dr. ir. F. Van der Wilk, Prof. Dr. ir. B.C.J. Zoeteman.

#### Writing group

A writing group consisting of drs. ing. R. Mampuys and Dr. D. Stemerding wrote this publication based on the yields from the abovementioned activities.