

**Report by Ireland on the Socio-Economic Impacts of the Marketing of
Genetically Modified Organisms
October 2010**

Introduction

Irish policy in respect of the cultivation of Genetically Modified Organisms is based on the objective in the Renewed Programme for Government (October 2009) to declare the Republic of Ireland a GM-free zone, free from the cultivation of all GM plants. In line with this national policy and in recognition of the concerns of some other EU Member States in relation to the cultivation of GMOs, Ireland has endeavoured to ensure its voting position at Environment Council in recent years has been consistent both with the objective of declaring the State free from GM cultivation and with the principle of subsidiarity. Currently, the only area where subsidiarity is permitted within the EU regulatory framework on GMOs is in regard to co-existence between authorised GM crops and non-GM crops. In accordance with guidelines issued by the European Commission, Member States may take certain measures to avoid the unintended presence of GMOs in other products.

However, Ireland would favour modification of the wider regulatory framework to allow individual Member States greater autonomy in decision making on the cultivation of GM crops and the strengthening of environmental risk assessment procedures, both in terms of the role of national competent authorities and the European Food Safety Authority.

Agri-food and fisheries is Ireland's largest indigenous industry, employing 150,000 people and with annual output of approximately €24 billion. The sector is regarded as key to an export-led economic recovery. The geographical distribution of the agri-food and fisheries sector is significant, as it plays an important role in the socio-economic fabric of rural and coastal communities. Farming in particular has a crucial role to play in terms of development that is both economically viable and environmentally sustainable. In this context, it is worth noting that a significant artisan food sector has emerged in Ireland in recent years, in response to strong consumer demand for locally produced, hand-crafted food products.¹ The organic sector, while small in relation to agriculture as a whole, also represents a considerable opportunity for future growth.

¹ Food Harvest 2020: A Vision for Irish Agri-food and Fisheries <http://www.agriculture.ie/>

The value of the domestic organic market is approximately €100m annually and the sector is particularly suited to small-scale production, which is at odds with the large-scale, mono-culture type production often associated with GM cultivation. In terms of the socio-economic impacts of the cultivation of GM crops, the submissions received in response to the national public consultation indicate a predominantly negative attitude to GMOs among the public. Broadly speaking, a number of respondents felt that Ireland would benefit economically and socially by maintaining a GM free position, as outlined in the Programme for Government commitment, and by marketing agricultural produce accordingly. This view is consistent with ongoing efforts to market Ireland as a source of high quality, safe and naturally based produce.

To date, there has been no cultivation in Ireland of GM crops on a commercial scale. Therefore, Ireland has had no experience with *ex-post* socio-economic consequences of GM crops that have been approved for use in the EU. The responses outlined in this document summarise the comments received in response to the public consultation and reflect both the variety of the respondents and the diversity of views expressed. Notwithstanding some of those views, Irish policy on GMOs is as articulated above, with the backing of farming associations, grower representatives, NGOs and the general public.

Member State: Ireland

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EU legislation on Genetically Modified Organisms provides for an assessment of the socio economic implications of deliberate releases and placing on the market of GMOs through direct reference (Directive 2001/18/EC) and indirectly by reference to "other legitimate factors relevant to the matter under consideration" (EU Regulation 1829/2003).

The European Commission noted in 2004 that there was insufficient experience to make such an assessment. The Commission therefore invited Member States to submit all information they would consider relevant, so as to initiate an analysis of socio-economic implications.

What are GMOs?

GMO is an acronym for Genetically Modified Organisms.

An organism is any living animal or plant including a bacterium or virus that is capable of reproduction. Plants and animals are composed of many different cell types and each cell contains within it copies of all its genes. Genes are made of DNA (deoxyribonucleic acid) and hold the information that determines the organism's particular form and function. Certain characteristics of an organism may be linked to a particular gene or combination of genes, for example flower colour.

For centuries, crop plants and livestock have been cross-bred such that the genetic make-up of offspring has been altered to select for desired traits and/or qualities. Traditional plant and animal breeding techniques require that the individual species involved are the same or closely related and such conventional plant breeding employs natural genetic variations to improve crops. Further development took place with the introduction of mutation breeding involving the artificial increase of mutation rates for subsequent selection. The development of genetic engineering techniques has meant it is possible to insert genes from another organism, or otherwise alter its genetic makeup, with a goal of introducing, deleting or enhancing particular traits in an organism.

Genetically Modified Organisms are defined in EU Legislation as 'those in which the genetic material is altered in a way that does not occur naturally by mating or natural recombination'.

Where GMOs comprise bacteria, viruses, viroids and animal and plant cells in culture they are referred to as Genetically Modified Micro-Organisms or GMMs.

Where GMOs comprise GM plants or GM animals otherwise known as transgenic plants or transgenic animals, they are referred to as GMOs

Legislation on GMOs – Irish Context

Legislation on GMOs is made taking account of the common framework for assessment and control of GMOs by which Ireland, in common with all Member States, is bound. EU legislation on GMOs has been in place since the early 1990's, and is focused on two main objectives:

- To protect human health and the environment.
- To ensure the free movement of safe genetically modified products in the European Union.

The potential environmental impact of GMOs is regulated under the following pieces of legislation:

- EU Directive 2001/18/EC on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EC, transposed into Irish law under the Genetically Modified Organisms (Deliberate Release) Regulations 2003 (S.I. No. 500 of 2003);
- EU Regulation 1829/2003 on genetically modified food and feed;
- EU Regulation 1830/2003 concerning the traceability and labelling of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC;
- EU Directive 2009/41/EC repealing and replacing Directive 90/219/EEC on the contained use of genetically modified micro-organisms transposed into Irish law under the Genetically Modified (Contained Use) Regulations 2001 (S.I. No. 73 of 2001) and the Genetically Modified (Contained Use) (Amendment) Regulations 2010 (S.I. No 442 of 2010).
- Regulation 1946/2003 on the transboundary movement of GMOs, transposed into Irish law under the Genetically Modified Organisms (Transboundary Movement) Regulations 2004 (S.I. No. 54 of 2004).

Government Role

The Minister for the Environment, Heritage and Local Government has responsibility for policy matters in relation to Directives on the Deliberate Release of GMOs into the Environment and the Contained Use of GMMs.

The Department of the Environment, Heritage and Local Government is also responsible for certain functions under Directive 2001/18/EC, e.g. decisions to place GMOs on the market under Article 18 of the Directive.

The Environmental Protection Agency is the authority in Ireland that implements GMO Regulations on:

- The contained use of GMMs
- The deliberate release of GMOs into the environment
- The transboundary movement of GMOs

The Department of Health and Children has responsibility for policy matters concerning genetically modified food. The Food Safety Authority of Ireland is responsible for the enforcement of GM food regulations, ensuring that only EU authorised products are on the market and that such products are appropriately labelled.

The Department of Agriculture, Fisheries and Food is responsible for:

- Regulating seed of certain species for marketing and cultivation
- Regulating animal feed that contains or is derived from authorised GM crops
- Developing a national strategy to ensure the co-existence of authorised GM crops with other crops
- Authorisation and control of marketing of pesticides for use on crops, including GM crops.

Current Government Policy:

The revised Programme for Government contains the following commitments with regard to GM crops.

- *We will declare the Republic of Ireland a GM-Free Zone, free from the cultivation of all GM plants.*
- *To optimise Ireland's competitive advantage as a GM-Free country, we will introduce a voluntary GM-Free logo for use in all relevant product labelling and advertising, similar to a scheme recently introduced in Germany*

Ireland is politically supportive of a right of self-determination concerning cultivation of GM crops and has previously supported the adoption of Council conclusions to promote better practice in the assessment and control of GM crops intended for cultivation in the EU at the level of the individual Member State. This position takes cognisance of the commitment in the Renewed Programme for Government to declare the State a GM free zone.

Given the Programme for Government commitment, Ireland's position on GM cultivation was not previously reflected in the provisions of the EU regulatory system. It is hoped that the package developed in July 2010 should enable greater EU-wide flexibility in considering specific local, regional and national conditions and the cultivation of GM, conventional and organic crops.

Consultation Process:

With a view to framing an appropriate response from Ireland, the Department of the Environment, Heritage and Local Government sought observations on the socio-economic impacts of the placing on the market of Genetically Modified Organisms for cultivation. A consultation process was initiated on 3rd February 2010 and closed on 24th February 2010.

The consultation process, which took a questionnaire format, was publicly advertised and was also hosted on the Departmental website at www.environ.ie.

This document contains an overview of responses received.

Questionnaire Instructions:

As previously mentioned, the consultation document utilised a questionnaire format to focus and facilitate commentary on the potential socio-economic implications of the placing on the market of GMOs. However, space was also given to allow respondents to include observations on additional topics they considered relevant.

The questionnaire was broken down into three sections;

- 1) Economic and social implications of the placing on the market of GMOs for cultivation.
- 2) Agronomic sustainability.
- 3) Submission of additional comments.

Respondents were also asked to include contact details and to indicate the nature of their interest in this consultation process.

Areas and stakeholders on which Member States are invited to comment

1 - Economic and social implications: influence on concerned economic operators

Upstream

1.1. Farmers

For each question, answers can be broken down by the range of stakeholders:

- *farmers cultivating GM crop;*
- *and/or conventional crops,*
- *and/or organic crops,*
- *beekeepers,*
- *seed producers producing GM seeds,*
- *seed producers producing conventional seeds,*
- *seed producers producing organic seeds;*

1.2. Seed industry

For each question, answers can be broken down by the range of relevant stakeholders, including:

- *plant breeders;*
- *multiplying companies;*
- *seed producing farmers,*
- *seed distributors,*

Downstream

Consumers

Cooperatives and grain handling companies

Food and feed industry

Transport companies

Insurance companies

Laboratories

Innovation and research

Public administration

Economic context

Internal market

Specific regions and sectors.

2 - Agronomic sustainability

Biodiversity, flora, fauna and landscapes

Renewable or non renewable resources

Climate

Transport / use of energy

3 - Other Implications

Overview of responses:

In total, 53 submissions were received in response to the public consultation. For the purposes of this report these have been broken down into the following categories: academic R&D; agribusiness R&D; beekeeper; consumer; farmer; organic farmer; Government agency; industry representatives and interest groups/NGOs. However some respondents fell into several categories, or represented multiple categories.

Academic(s)	4 (2 of these were international academics)
Agribusiness Research & Development	1
Beekeeper	1
Consumer	17
Farmers/Growers	6
Government Agencies	2
Food Producers	1
Interest Groups/NGOs	9
Organic Farmer	11
Industry Group	1

At the time of the launch of the consultation process, an advertisement was placed in the national press and the Department directly notified relevant stakeholders that the consultation was taking place.

Due to the wide ranging nature of submissions received, responses have not been classified in percentage terms. Several submissions were very comprehensive, covering a wide range of issues, while others focused on one particular issue. Other respondents simply wanted to place on record their approval or disapproval of GM crops and of Government policy in this area.

In line with the theme of the consultation process, this document focuses on contributions specifically dealing with the socio-economic implications of the placing on the market of GMOs including socio-economic benefits and risks and agronomic sustainability.

Broadly speaking anti-GMO respondents felt that Ireland would benefit economically and socially by maintaining a GM free stance, as outlined in the Programme for Government commitment, and by marketing agricultural produce accordingly.

Pro-GMO respondents believed that a restrictive GMO policy would mean that the EU and Ireland would become increasingly unable to compete effectively in the international agricultural research and innovation sectors.

1. - Economic and social implications

Upstream

Background

Agriculture forms a vital part of the Irish economy, generating in excess of €8 billion in exports and providing predominantly rural-based employment for over 110,000 people. Over 3.9 million hectares (m ha) or 91% of available agricultural land is devoted to pasture-based systems, with approximately 9% (0.4 m ha) devoted to arable production (Department of Agriculture and Food, 2007).

To date, there has been no cultivation in Ireland of GM crops on a commercial scale by Irish farmers. Therefore, Ireland has had no experience with *ex-post* socio-economic consequences of GM crops that have been approved for use in the EU.

As a consequence, most respondents to this questionnaire necessarily focused on expected socio-economic implications of GM crops that are pending approval and those that are under development and are not authorised in the EU (*ex-ante*).

Similarly, research and projections by the Environmental Protection Agency (EPA) and Teagasc (the agriculture and food development authority in Ireland) were cited by multiple respondents, as was international experience to date.

1.1. Farmers

- farmers cultivating GM crops;

As stated above, there has been no cultivation in Ireland to date of GM crops on a commercial scale by Irish farmers and responses here are based on research and on experiences internationally.

GM crops most suited to the Irish agri-environment include: herbicide tolerant oilseed rape and maize; late blight resistant potato; fungal resistant (against *Septoria* and *Fusarium* disease) wheat; nitrogen use efficient wheat, barley, potato and oilseed rape².

For blight resistant potato alone, the net benefit to the grower is calculated to be in excess of €198/ha³. The subsequent benefit to farmers for the other crops listed would vary significantly and would be dependent upon the crop management regimes farmers would be obliged to adopt.⁴

Research carried out by Teagasc found that the primary reason farmers will choose GM crops over conventional varieties is due to the potential of GM varieties to

² O'Brien, M and Mullins, E. (2009) *Relevance of genetically modified crops in light of future environmental and legislative challenges to the agri-environment* Annals of Applied Biology, Vol 154, Issue 3, pp 323-340

³ Flannery, M-L, et al (2004), *An Economic Cost-Benefit Analysis of GM Crop Cultivation An Irish Case Study*, Journal of Agrobiotechnology Management and Economics, vol.7(4). p 149-157

⁴ Report of the Working Group on Co-Existence of GMO and Non GMO Crops: http://www.agriculture.gov.ie/gm_coexistence/

generate additional income and/or increase the time for the farmer to perform ancillary management tasks

Multiple respondents cited the results of a Teagasc survey which indicated that circa 26% (ca 30 000) of the farmers surveyed indicated that they would consider growing GM crops should they provide cost savings or greater flexibility in crop management (Teagasc, 2007).

According to Teagasc⁵, *Phytophthora infestans* (late blight) continues to be a major problem in Ireland, causing annual losses in yield and quality estimated at €15 million per annum. Currently, under Irish climatic conditions, in order to protect the potato crop, this pathogen requires as many as 14 fungicide applications during the planting season to ensure adequate protection. The Teagasc study concluded that the commercialisation of a specific GM late-blight-resistant (GMLBR) potato variety could potentially offer a significant cost savings to the producer up to €199 ha if a market materialised.

In a 2004 publication entitled '*An Economic Cost-Benefit Analysis of GM Crop Cultivation. An Irish Case Study*', Teagasc researchers looked at the predicted costs and/or benefits a producer could experience if a selected group of GM crops (winter wheat, spring barley, sugar beet, and potato) were cultivated in Ireland. The study concluded that potential exists for GM crops to be more profitable for Irish farmers than conventional crops, if seed and coexistence costs are offset by savings in pest or disease control costs and/or by higher yields. These specific crops were selected for evaluation based on their level of economic importance to Irish agriculture. The described traits (disease resistance and herbicide tolerance) were also selected because of the difficulties these issues impose upon present Irish crop management regimes.

These studies suggest that there might be an economic impact with little social impact if certain GM crops were cultivated by Irish farmers.

Conversely, the Irish Cattle and Sheep Farmers Association argued that:

"The EU Directorate-General for Agriculture reports that, of the studies reviewed in their research, conclusive evidence was not apparent to support the on farm-level profitability of GM crops." (DG Agri, 2000).

Multiple respondents on behalf of farmers and the farming sector felt the current GMO model is of benefit primarily to very large-scale mono-culture type production and that this was not a model of production which would prove suitable for the Irish market.

⁵ Flannery, M. et al, *An Economic Cost-Benefit Analysis of GM Crop Cultivation An Irish Case Study*, AgBioForum, 2004, Vol. 7, No. 4, p. 149-157
http://www.gmoinfo.ie/index.php?option=com_content&task=view&id=76&Itemid=

- *and/or conventional crops;*

Economic aspects

The agri-food sector accounts for over 6.6% of gross value added and 8.5% of employment, with export values amounting to €8.2 billion in 2008 (DAFF, 2009). Ireland's main export commodities are dairy and beef, representing 29% and 21% of exports, respectively. Virtually all Irish beef continues to be destined for EU markets. Ireland exports an average of 90% of its beef production.

Most farmers and farmer representative groups responding to the consultation process were opposed to GM crops and felt that their business would be negatively impacted if GM cultivation commenced in Ireland.

Respondents generally felt that retaining GM-free status offered far more economic potential and would allow Irish farmers to access higher value markets. The growing preference within the EU for high quality goods, coupled with the importance of the EU market for Ireland was cited by multiple respondents.

For example, the Irish Cattle and Sheep Farmers Association (ICSA) argued that:

“GM cultivation is not to the advantage of the majority of Irish farmers, or to the advantage of food-tourism and is therefore detrimental to the agri-food sector and consequently to the rural economy. Other EU regions, such as the Rhone-Alpes with its six million inhabitants, have demonstrated the benefits to the tourism industry with high quality local food and its GM-free status. Ireland's potential to develop this market is yet to be realised.”

ICSA also noted that cereal production in Ireland is already achieving relatively high yields (Teagasc, 2010); and that any increased profit from GM crops would have to be derived from reducing input costs.

Given that GM seeds are more expensive than conventional hybrid (DG Agri, 2000), and the GM crop does not return a premium price (it may in fact lead to discounted prices) ICSA felt that it was difficult to find any significant economic benefits from Irish GM cultivation.

It should be noted, however, that some tillage farmers felt that Irish and EU farmers were limited by current GM policy, while having to compete against imported GM produce.

Social aspects

In considering the social impact of GM crops, most farmers and farmer representative bodies focused on the problem of cross-contamination.

It was the view of the ICSA that, *“the agricultural land use of Ireland and farming practices are not conducive with the co-existence of GM cultivation due to the*

interconnectedness of Irish agricultural systems. The potential for cross-boundary and other pathways for contamination between conventional and GM crops could result in many disputes and potential legal arguments between neighbouring farmers ”

Similarly the Irish Apple Growers Association commented that, “*the risk is that conflicts will arise between farmers, as some may grow them, and some will want to be able to have certified GM-free crops. Because Ireland is such a small country, the likelihood of contamination by pollen movement is high, as necessary exclusion zones would probably be unworkable. For apples, an exclusion zone of 10km from a GM orchard to a non-GM orchard or wild apple tree would be appropriate (despite promoting companies’ opinion that lower exclusion zones are workable, experience in other countries have shown this to be incorrect).*”

- and/or organic crops;

Organic farmers responding to the consultation process were strongly opposed to GM crops and felt that their business would be negatively impacted if GM cultivation commenced in Ireland.

As with farmers of conventional crops, the main problems highlighted were those of co-existence and the additional costs to protect organic crops from cross-contamination.

It was argued that permitting GM cultivation would not only limit the opportunities for a farmer to grow non-GM crops but it would also damage Ireland’s organic strategy. These issues would create a social impact through causing disputes within the farming and rural community.

The additional costs and requirements on conventional and organic farmers, arising from the need to segregate supply chains, were also raised.

Farmers also mentioned the increasing lack of availability of GM-free protein feed.

In summary, for both conventional and organic farmers, the major issues associated with GM cultivation are as follows:

- that GM cultivation should not impinge on the rights of neighbouring farms to maintain a GM free status;
- full observation of buffer zones; some farmers were sceptical of the sufficiency of the existing buffer zone requirements;
- the issue of liability in the event of cross-contamination;
- the overall negative perception in the farming community with regard to GMOs; and
- the possibility of legal disputes and/or conflicts between neighbouring farmers on GM farming policy.

- beekeepers;

Economic aspects

Beekeepers felt that consumer perception of Irish honey would be severely damaged if the end product was perceived to be GMO contaminated. Honey produced in a GM area would also prove to be more difficult to market, certainly at a premium price.

The Banner Beekeepers Association cited examples in the UK where beekeepers had relocated their hives from areas where GM crops were planted, as they felt they would no longer get a market for honey produced in a GM area.

The Association also commented as follows: *“Technically GM crops grown within a 6 mile radius of a beekeeper’s apiary/ies would mean that the honey would be potentially contaminated by GM honey and pollen. It would no longer be perceived as a premium product.”*

Social aspects

Respondents queried the legal protection available to beekeepers to protect against financial loss due to the reduced marketability of their product or for the establishment of beehives in GMO cultivation areas.

-seed producers producing GM seeds;

To date, there has been no cultivation in Ireland of GM crops on a commercial scale by Irish farmers.

-seed producers producing conventional seeds;

The Irish Grain and Feed Association (IGFA) represents the importers of feed raw materials (over 2 million tonnes), the manufacturers of compound feed (3.5 million tonnes) and the handlers of the majority of domestic grain for the Irish feed industry (1.3 million tonnes).

Members are both independent companies and farmer controlled businesses. Many are part of large, integrated Agri-food businesses. IGFA noted in their submission that they derive no direct benefit from Biotech crops and do not have any Biotech companies as members.

The IGFA expressed confidence in the European regulatory regime for GMO food/feed and cultivation and felt that independent risk assessments / opinions provided by EFSA should be supported by member states.

“Any new technology can be expected to bring economic and social implications. The challenge for us, is how to utilise these technologies in a balanced manner and to support the availability of sustainable systems to all growers both large and small scale.”

Other respondents noted that additional measures would be required to protect against GMO contamination and felt that the marketing of GM seeds would have a negative impact on the seed industry for plant breeding and seed producing sectors by increasing costs associated with the protection and certification of genetic purity of seed lines.

- seed producers producing organic seeds;

As stated above, additional measures would be required to protect against GMO contamination.

Has GMO cultivation an impact regarding the following topics? If so, which one?

The Agricultural Science Association felt that benefits to farmers' revenue could stem from reduced pesticide inputs, improved pest control leading to improved yield, and, ultimately, a benefit to the producer in terms of income. Further benefits will be evident as disease resistant GMs are marketed (e.g. potato blight resistance). ASA felt that it would be critically important that Irish farmers were not disadvantaged compared to other EU farmers in whatever regulations emerge.

The comments of organic and conventional farmers, under the general economic aspects segment, are also relevant here. In the event of cross-contamination occurring, GMO-contaminated organic products would have to be sold at reduced rates. The possibility of longer term commercial damage occurring, due to damaged perception, was also mentioned. Most conventional and organic farmers responding to the survey expected GM crops to adversely affect income.

-farmers' production costs;

The Agricultural Science Association (ASA) noted that the Irish animal feed industry relies significantly on imported sources of protein in the form of maize and soya by-products. The ASA is concerned about recent changes in Irish policy which it feels may have contributed to increased delays in the approval of new GM soya and maize varieties. As non-GM sources of soya and maize carry a significant price premium, the Association feels that this policy puts production of Irish livestock products at a disadvantage relative to international competitors.

-labour flexibility;

The Agricultural Science Association noted that the current weed control regime in Irish production requires precision timing and, in the case of most crops, multiple applications. The glyphosate resistance of GMO crops increases the flexibility of timing and reduces the number of applications required. This could allow for increased labour flexibility.

- *quality of the harvest (e.g. mycotoxines);*
- *cost of alternative pest and/or weed control programmes;*

The Agricultural Science Association is of the view that reduced herbicide/pesticide applications in GM crops could substantially reduce input costs and would reduce soil compactions and environmental load.

- *price discrimination between GM and non-GM harvest;*

At production level, Ireland has relatively low maize production and no cotton or soya-crops, where the major advances in GM have taken place.

The Agricultural Science Association felt that benefits to tillage growers and to the tillage sector would, therefore, arise from advances in grain and other crops grown in Ireland.

- *availability of seeds and seed prices;*
- *dependence on the seed industry;*

The Irish Cattle and Sheep Farmers Association is of the view that the long-term impact of reducing choice is more expensive seed and mono-culture dependency on the herbicides and pesticides that accompany these products.

“This in turn will impact on farm-income. From 1975 to 1997 soybean farmers spent 4% to 8% of crop income on purchase of seed⁶ In 2009, farmers planting GM soybean seeds spent 16.4% of soybean income on seed, twice the historic norm Since 1996, the price of conventional seed has risen just marginally, whereas GM seed has on average doubled.”

- **farmers' privilege (as established by Article 14 of Regulation (EC) No 2100/94 on Community plant variety rights) to use farm-saved seeds;**

The ICOSA view is that, from a farmer's point of view, the implications of seed patenting is disturbing. The right to produce your own seed must not be undermined.

- ***the use of agriculture inputs: plant protection products, fertilisers, water and energy resources;***

The view has been expressed by some NGOs that, *“immediately after introduction of deliberate cultivation of GMO crops the trend is for the use of pesticides to fall and for a movement from pre-sowing herbicides to late growth application. However, pest resistance to Bt, herbicide resistance development, and the increase in the number of non-Bt susceptible pest species in crops such as cotton and maize, seems to be a phenomenon noted all over the world seven to ten years after introduction”* (Sonairte: The National Ecology Centre). There is a consumer perception that this could

⁶ Benbrook, C. *The Magnitude and Impacts of the Biotech and Organics Seed Price Premium*. The Organic Centre: www.organiccentre.org/reportfiles/seeds_final_11.03.09.pdf

potentially lead to an increase in the use of a wider variety of pesticides and herbicides

- health of labour (possible changes in the use of plant protection products);
- farming practices, such as coexistence measures and clustering of GMO and/or non-GMO production;

- cost of coexistence measures;

This cost is difficult to quantify in Ireland, due to a lack of experience in dealing with GM products. However comments received suggest that it would seem appropriate that GM cultivators would bear responsibility for the cost of any co-existence measures. These may prove to be significant, and could vary considerably based on the landscape in question as well as the business type of neighbouring farmers.

-conflicts between neighbouring farmers or between farmers and other neighbours;

As mentioned earlier, farmers generally contended that the possibility for conflict exists where a farmer or beekeeper felt that the decision of a neighbouring farmer to opt for GM cultivation impinged on their right to maintain a GM free status and/or they feared for the economic viability of their crop as a result

The Agricultural Science Association suggests that conflicts between neighbouring farmers or between farmers and other neighbours represents a potential negative social aspect to the introduction of GMOs and that this could only be mitigated by use of coexistence measures that are based on the most up-to-date scientific knowledge.

- labour allocation- insurance obligations;
- opportunities to sell the harvest due to labelling;

According to the Agricultural Science Association this should not be an issue as labelling legislation is already in force in Europe and food produced from animals fed feed of GM origin does not require labelling. A potentially negative social implication here is the targeting of GM produce by dissident movements.

- communication or organisation between the farmers;
- farmer training;

The Agricultural Science Association believes that the issue of farmer training is critical in preventing widespread disharmony and is highlighted in the Irish coexistence guidelines. Training would be required for producers and also for their neighbours.

1.2. Seed industry

For each question, answers can be broken down by the range of relevant stakeholders, including:

- *plant breeders;*
- *multiplying companies;*
- *seed producing farmers;*
- *seed distributors,*

And/or:

- *GM seeds;*
- *conventional seeds;*
- *organic seeds;*

And/or

- *industrial / arable crops;*
- *vegetable crops ..*

Has GMO cultivation an impact regarding the following topics? If so, which one?

- **employment, turn over, profits;**
- **the production of seeds (easiness/difficulty to find seed producers, easiness/difficulty to find areas to produce these seeds...);**
- **marketing of seeds;**
- **the protection of plant breeders rights; - the protection of plant genetic resources.**

According to the Agricultural Science Association, large scale GM adoption is unlikely in the EU for the foreseeable future. The Association also believes that a sound legislative framework including traceability and labelling should foresee a functional seed industry capable of serving conventional, GM and organic farming.

Does the marketing of GM seeds have an impact on the seed industry and its structure in the EU (size of companies, business concentration, competition policy)? Please specify per sector.

- for plant breeders;
- for seed multiplication;
- for seed producers;
- for the availability of conventional and organic seeds;
- creation/suppression of barriers for new suppliers;
- market segmentation.

Syngenta Ireland (an agribusiness and research company) has expressed the view that, *“subject to existing laws and regulations, the impact on the market would be very similar to the introduction of non-GM varieties. Market forces decide on availability of varieties.”*

Teagasc pointed out that the existing seed industry in Europe is already consolidated.

“The introduction of GM seeds through the present system is likely to be driven by < 3 companies, who can be expected to control the market for those particular varieties. However the provision of GM seed would not preclude farmers from growing conventional varieties and will not impact on the availability of conventional and/or organic certified seed. Indeed should GM varieties become available in the near future, it is anticipated that GM adoption is unlikely to exceed 30%, due to the management regimes that GM farmers will have to adopt. As such, the provision of GM seed by local seed merchants will continue in parallel with the availability of conventional and organic equivalent seed lots.

It will be necessary to ensure the appropriate segregation of GM and non-GM varieties through each stage of production but this will not represent a barrier to the production of conventional and organic material. Rather, it will guarantee the genetic integrity of non-GM varieties and assure non-GM farmers as to the purity of their stocks.”

However the view of the Leitrim Organic Farmers group is that the sale of such seeds would put extra costs on seed suppliers in terms of preventing cross contamination, e.g. distribution, and points to the cleaning of equipment.

“The long-term impact of reducing choice is more expensive seed and mono-cultured dependency on the herbicides and pesticides that accompany these products. This in turn will impact on farm-income. From 1975 to 1997 soybean farmers spent 4% to 8% of crop income on purchase seed⁷. In 2009, farmers planting GM soybean seeds spent 16.4% of soybean income on seed, twice the historic norm. Since 1996, the price of conventional seed has risen just marginally, whereas GM seed has on average doubled” (ICSA)

Downstream

1.3. Consumers

Has GMO cultivation any impact regarding the following topics? If so, which one?

- consumer choice (regarding quality and diversity of products);

Several NGOs and consumer respondents argued that an increase in genetically modified crops would have an extremely negative impact on consumer choice.

“Genetically engineered crops also have real implications on consumer choice. Consumers who are concerned about the lack of research into genetically engineered crops and the methods used to produce the food they eat could well find that choice increasingly unavailable, particularly as co-existence of genetically engineered crops with conventionally bred crops or organic crops may well be impossible.” (VOICE - Voice of Irish Concern for the Environment)

⁷ Benbrook, C. *The Magnitude and Impacts of the Biotech and Organics Seed Price Premium*. The Organic Centre: www.organiccentre.org/reportfiles/seeds_final_11_03_09.pdf

The Irish Doctors Environmental Association also strongly feels that consumer preference is of major socio-economic consideration and fundamental to the debate on Irish GM cultivation. Many Member States and/or regions have adopted a GM-free cultivation stance with additional GM labelling for products of animal origin in response to consumer demands. With an ever-growing EU-wide consumer preference for non-GM ingredients and clear labelling of GM food, (DG Agri, 2000) the economic and business strategy of Ireland should be targeted at that market.

Health concerns are a major concern to the consumer, and it appears no amount of biotech promotion can persuade them otherwise. Overall, Europeans think that GM food should not be encouraged. GM food is widely seen as not being useful, as morally unacceptable and as a risk for society (Eurobarometer, 2006).

Consumers have indicated they simply do not wish to eat a plant that produces its own pesticide or plants that withstand direct application of herbicides (Eurobarometer, 2006). They have also indicated awareness of the additional residues levels in food produced from GMOs. These findings are evident from independent research that shows EU consumers do not see the benefit to them and this will influence their purchasing decisions. (Eurobarometer, 2006).

GM technology needs to be viewed within the cultural and agri-dynamics of each country as well as the social and economic context. Public acceptance plays a critical role in the issue of GMOs. To date, the trend in European public opinion is towards a rejection of GM food. It could be an impediment to Irish agricultural exports as well as indicating a complete lack of EU consumer awareness to permit the cultivation of GM crops. (ICSA)

***-the price of the goods;
-consumer information and protection;***

Any other impact you would like to mention:

Where non-GM sources of soya and maize (used as animal feed) carry a significant price premium (Benbrook, 2009) this could mean that production of Irish livestock products is at a disadvantage relative to international competitors.

1.4. Cooperatives and grain handling companies

Has GMO cultivation any impact regarding the following topics? If so, which one?

- work organisation;**
- handling and storage;**
- transport;**
- administrative requirements on business or administrative complexity.**

Regarding work organisation, the IGFA has expressed the view that it is the balanced and informed adoption of agricultural techniques that helps maintain our environment. Mono-cropping, over grazing, excessive fouling, or indeed ploughing can also be a

bigger factor. It is the informed and dynamic application of the correct agronomic for different soil types, regions and different output requirements that deliver sustainability. No one technology can deliver alone.

Any other impact you would like to mention:

It is the view of IGFA that it is disproportionate to apply different criteria or requirements (i.e. socio-economic) to the products of biotechnology when these criteria are not also required of conventional or other new technologies. Once the scientific opinions are in place it should be left to the normal working of the market to recognise and translate the socio-economic through supply and demand.

1.5. Food and feed industry

Has GMO cultivation any impact regarding the following topics? If so, which one?

- range of products on offer;
- employment, turn over, profits;
- work organisation;
- crop handling (drying, storage, transport, processing, etc...);
- administrative requirements on business or administrative complexity;

Any other impact you would like to mention?

As Ireland does not cultivate GM crops, this question cannot be answered conclusively based on Irish data.

1.6. Transport companies

Has GMO cultivation any impact regarding carriers (insurance, cleaning, separate lines...)? If so, which one?

No responses received

1.7. Insurance companies

Does the GMO cultivation have any impact regarding insurance companies (e.g. in terms of developing new products)? If so, which one?

No responses received

1.8. Laboratories

Has GMO cultivation any impact regarding the following topics? If so, which one?

- employment, turn over, profits;
- feasibility of analyses;
- time necessary to provide the results;

- prices of the analyses.

Any other impact you would like to mention:

No responses received

1.9. Innovation and research

Do GMO cultivation and the technology spill over have an impact on the following topics? If so, which one?

- investment in plant research, number of patents held by European organisations (public or private bodies);
- investment in research in minor crops;
- employment in the R&D centres in the EU;
- use of non-GM modern breeding techniques (e.g. identification of molecular markers);
- access to genetic resources;
- access to new knowledge (molecular markers, use of new varieties in breeding programmes, etc.).

The Irish Grain and Feed Association consider that it is a fundamental right that all stakeholders in the feed/food chain have equal access to the best available scientific technology. The Association feels that scientific and commercial innovation is as vital to this sector as it is to any other.

Confidence by the public in the regulatory system on the release of GM products will be crucially important for both consumers and producers of food. In this context, the role of public research, as opposed to self-interest research by multinational corporations is an important element. Obviously Ireland is part of the EU regulatory system, and the European Food Safety Authority needs to have adequate resources and expertise to ensure that GM products are placed on the market only when the authorisation decision is made on a sound scientific basis. A "cautious approach" needs to be adopted by the regulatory authority, so that the confidence of consumers is maintained. (Con Lucey, Former IFA Economist)

1.10. Public administration

Has GMO cultivation any impact regarding the actions of the national public administrations and the necessary budget (national and local level) for example policing and enforcement costs?

Any other impact you would like to mention:

To date, no GMOs have been cultivated in Ireland. It can be expected that checking compliance with legal regulations and additional administrative requirements will incur significant administrative expenditure.

The Irish Grain and Feed Association noted that China and India had developed policies of supporting new technology and indigenous seed companies through public research institutions.

“Novel technologies are made available directly to indigenous seed companies. The emphasis is on getting technology early to the indigenous market players.”

The IGFA felt that the EU system, *“favours the large players due to increased cost and complexity. This has in reality discriminated against smaller indigenous players and fostered market dominance by the large private seed houses. It is clear there is a need for public sector, farmers and breeders to develop a better relationship when it come to GMO as the varieties are protected by patent. The ability of public researchers to access material and develop direct links with suitable commercial partners does need to be balanced in a progressive way. Protection of intellectual property rights is a corner stone of the EU competitiveness agenda and therefore does also apply to all agricultural stakeholders equally.”*

Economic context

1.11. Internal market

Does the placing on the market of GMO seeds have an impact on the functioning of the EU internal market on seeds? If so, which one?

Does it have an impact on the internal markets for services (if so which impact and which services), for agriculture products and on workers' mobility? If so, which one?

Does GMO cultivation have an impact on monopolies? If so, which ones (emergence/disappearance)?

Does it provoke cross-border investment flows (including relocation of economic activity)?

Any other impact you would like to mention:

See comments in 1.10 above.

1.12. Specific regions and sectors

Answers can be broken down on the purpose of the level (national, regional, local) and according to region.

Has GMO cultivation any regional and local impact in those regions regarding the following topics. If so, which one?

- agriculture incomes;
- farms' size;
- the farm production practices (e.g. increase or decrease of monoculture);
- the reputation regarding other commercial activities of the region/localities.
- Any other impact you would like to mention:

A number of respondents noted that GM crops were more suitable for monocultural type farming and felt that this was unsuitable for Ireland.

2. - Agronomic sustainability

2.1 Agricultural inputs

Does the cultivation of EU approved GMOs for cultivation have an impact regarding the use of pesticides against target insect pests (i.e. corn borer)?

As Ireland does not cultivate GM crops, this question cannot be answered conclusively based on Irish data. The EPA response, for instance, focused on results from the use of GM Maize in Spain. At the time of the consultation process, only Bt maize MON 810 (Insect resistance (IR)) was under commercial cultivation in the EU (a GM starch potato, known as "Amflora" potato, was subsequently authorised for cultivation and industrial processing on 2 March 2010.)

Pest attack is a serious agricultural problem worldwide leading to yield losses and reduced product quality. Pests can cause damage both in the field and during storage in silos. Each year, pests destroy approximately >20 percent of food crops worldwide. MON810 contains a gene from the bacteria *Bacillus thuringiensis* that combats the corn borer pest which destroys maize crops.

On the basis of the Spanish experience, it could be argued that the use of GM IR maize would have a positive effect on human health and the environment, as farmers would have to use fewer chemicals to combat this particular pest.

It should also be noted that the legislation governing the application of Plant Protection Products (PPP) is currently being discussed at EU level and lead in Ireland by the Department of Agriculture, Fisheries and Food. The revision of this Directive 91/414/EEC is seeking a reduction in PPP application rates, which could substantially reduce the type of chemicals available to farmers in the EU. The ratification of this Directive may have serious ramifications for the existing programmes of disease control using PPP to control diseases caused by pests in EU Member States. Consequently in the case of the potato crop, the use of blight resistant potatoes either

using traditional plant breeding techniques or GM technology may have to replace the chemicals that have been used heretofore to control diseases on potatoes.

It is claimed that the use of GM insect resistant crops (IR) crops in some cases can harm beneficial insects and other non-target organisms. Extensive ecological impact assessments have been addressing these issues using Bt crops under post market monitoring plans in Spain over a ten year period. To date, no significant adverse effects on non-target arthropods nor any adverse effects on soil microorganisms (lack of gene flow from Bt maize to soil bacteria) have been observed⁸. (EPA)

Teagasc expressed the view that several GM varieties will receive EU authorisation in the near future. These will include (but not be exclusive to) herbicide tolerant oilseed rape and maize, late blight resistant potato, fungal resistant wheat and nitrogen use efficient wheat, barley and potato. This question (2.1) is most relevant to disease resistant potato and wheat, the cultivation of which will have a positive impact regarding use of pesticides. This is because each GM event has/is being designed to reduce pesticide inputs through the introduction of single/multiple transgenes, which will confer a disease resistant variety. Therefore, specific GMOs will have a positive impact regarding the use of pesticides against target insect pests, as pesticide requirements will be significantly minimised for these varieties.

Syngenta expressed the view that decreased use of pesticide has accompanied the use of Bt maize and with it has brought benefits such as reduced fuel, water and packaging requirements.

Does the placing on the market of GMOs have an impact, and if so which ones, regarding the use of pesticides or/and on the patterns of use of chemical herbicides?

Again, as GMOs are not currently cultivated in Ireland, we cannot provide definitive national data on impacts on biodiversity, fauna, flora and landscape.

The growth of weeds forces crops to compete for sunlight and soil nutrients which lead to yield losses. Because herbicides cannot differentiate between plants that are crops and plants that are weeds, conventional agricultural systems can only use 'selective' herbicides. Such herbicides do not harm the crop, but are less effective at removing all types of weeds. If farmers use herbicide tolerant crops, 'non-selective' herbicides can be used selectively to control weeds.

Potential **Advantages** of using GM herbicide tolerant (HT) crops:

- Enhanced flexibility in timing of weed control and reduced herbicide application frequency are widely claimed reasons to cultivate HT crops.
- GM HT-associated herbicides (glyphosate and glufosinate) are claimed to be less persistent than conventional herbicides.

⁸ http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1211902768091.htm

- Control of certain broad-leaf and grass weeds can be achieved with a single herbicide.
- HT crops facilitate low or no tillage cultural practices (minimum tillage), which many consider to be more sustainable, for example, result in lower input of energy (fuel) to produce the crop.

Potential **Disadvantages** of using GM HT crops:

- Potential emergence of HT weeds populations over time. For example, the continuous use of glyphosate in GM HT crops in the USA and other countries has resulted in the emergence of HT weed biotypes which might erode any initial benefit delivered by the GM HT trait. However, it should be noted that the development of herbicide resistance in weeds is not a question of genetic modification, as HT weed biotypes were prevalent long before the introduction of GM crops.
- Potential gene flow from the HT crop carrying the herbicide trait to a related weed species, thus conferring herbicide tolerance to that weed species.

It should be noted the results of the UK Farm Scale Evaluation (FSE) trials⁹ which were carried out over a number of years indicated that the herbicide programme used on oilseed rape and sugar beet had a negative effect on biodiversity. This was due to the fact that fewer weeds would be available later in the season for organisms at higher trophic levels (e.g. farmland birds) compared to conventionally managed OSR & beet. This effect was not seen in the FSE studies for GM herbicide tolerant maize, which gave some positive indications for biodiversity earlier in the season.

It should also be noted that another UK funded study (the Bright project)¹⁰ concluded that the GM varieties did not deplete the soil of weed seeds. This was in direct contrast to the FSE study, in particular for GM oilseed rape

In a paper presented by the EU Joint Research Council in 2009¹¹, the following preliminary conclusions on the ex-ante analysis of the potential adoption of HT crops in the EU were presented:

- Agricultural economics research is essential
 - to understand potential benefits of GM crops and its social distribution
 - to quantify indirect effects on the environment (i.e. changes in pesticide use)
- Experience and academic excellence exists in Europe, but few projects on-going

⁹ The Farm Scale Evaluations;

<http://webarchive.nationalarchives.gov.uk/20080306073937/http://www.defra.gov.uk/environment/gm/fse/>

¹⁰ Botanical and rotational implications of genetically modified herbicide tolerance in winter oilseed rape and sugar beet (BRIGHT Project); <http://www.hgca.com>

¹¹ EC/JRC research on global aspects of GM adoption and agricultural benefits of GM in Europe; <http://www.efsa.europa.eu/en/events/documents/gmo090914-p9.pdf>

- Networking, integration and funding needed

It is the opinion of the Environmental Protection Agency that, if such crops are cultivated in EU Member States, it is imperative that both Case Specific and General Surveillance post-market monitoring plans are implemented by the notifiers in accordance with the provisions of Directive 2001/18/EC and audited by the relevant authorities.

Teagasc: In order to maintain the sustainability of herbicide tolerant systems it is imperative that the adoption of herbicide tolerant (HT) maize and/or oilseed rape is completed in tandem with the adoption of an integrated weed management strategy, the goal of which is to identify production practises that reduce the risk of weed resistance to glyphosate and other herbicides ¹²

Syngenta commented that *“in the case of herbicide tolerant crops, the pattern of chemical use may change since the crop has been modified to be tolerant to certain herbicides (e.g. glyphosate). The responsible introduction of herbicide tolerant crops – involving well known practices of proper herbicide rotation and crop rotation – will increase the number of strategies available for growers in the prevention of herbicide resistance ”*

The Irish Apple Growers Association were of the view that there was ample data to show that herbicide use increases with the cultivation of herbicide-resistant crops, and the same would certainly happen here in Ireland. The Association also felt that the “magic bullet” effect of having a single “guaranteed” cure to weed problems means that other good agricultural practices that would reduce weed populations are ignored.

2.2. Biodiversity, flora, fauna and landscapes (other impacts than the ones considered in the environmental risk assessment carried out under Directive 2001/18 and Regulation (EC) No 1829/2003)

Does the cultivation of EU approved GMOs have an impact regarding the number of non agriculture species/varieties?

To date, there has been no commercial cultivation in Ireland; consequently there are no observed impacts on the aforementioned topics. However, it is the view of the EPA that the cultivation of GM crops will in all likelihood have little or no impact on non-agriculture species/varieties. It should be noted that good farm management practices can be implemented to protect non-agricultural species irrespective of the farming type, GM, conventional or organic cultivation practices.

Teagasc noted that in assessing the potential impact of specific GM crops upon the Irish landscape, four key biodiversity stressors were identified by Teagasc. These include: chemical inputs; introgression of transgenes into semi-natural habitats; nutrient applications; and management impacts.

¹² Hurley et al. (2010), *Effects of Weed Resistance Concerns and Resistance Management Practices on the Value of Roundup Ready® Crops*. Journal of Agrobiotechnology Management and Economics, Vol 12, Article 5

“Combined into a ‘CINMa’ index, a grading system was developed with the use of peer-reviewed published data. The CINMa model was applied to five GM crops of most relevance to Irish tillage systems. These include: Herbicide tolerant (HT) oilseed rape and maize, Nitrogen use efficient (NUE) oilseed rape and potato; Late blight resistant (LBR) potato. The study showed that for each of these crops there is significant potential to increase soil quality¹³. This must be seen as a positive step since soil biodiversity, especially agricultural soils, has significant economic consequences at a local and global level.”

Does GMO cultivation have an impact on agriculture diversity (number of plant varieties available, agriculture species, etc?)

According to a 2006 study funded by the EPA and carried out by Teagasc¹⁴ there is evidence that conventional methods of crop cultivation have had an adverse impact on the levels of biodiversity on Irish farms, with 15 of the 21 studies showing negative trends for the species/groups studied. This was in agreement with international literature. However, many of these studies found that when more environment-friendly farming practices are used on arable farms, adverse impacts on biodiversity can be reduced.

The EPA highlighted the importance of conducting environmental safety research on GM crops to ascertain if different traits (for example, herbicide tolerance) of genetically modified plants could have a positive/negative impact on biodiversity under Irish climatic conditions.

Such an environmental safety research programme should be targeted to ensure:

- that it is specifically designed to cater for issues relevant to the Irish environment e.g. climatic conditions, ecology, agronomic practices;
- that it is conducted in such a manner so as to ensure confidence in its outputs, e.g., requires that all results will be publicly available and that the scientists who carry out the research will have their work peer reviewed in recognised scientific journals; and
- that the results of the programme provide an input into the ongoing debate on the potential use of GM crops in Irish agriculture.

The EPA are of the opinion that it would be desirable that independent studies on potential environmental and human health effects (both short and long term) be carried out under Irish soil and climatic conditions on genetically modified crops prior to the commercial growing of GM crops in Ireland.

Teagasc felt that the cultivation of specific GM crops will impact positively on agricultural biodiversity. This was, *“not because of the crop itself but because the*

¹³ Mullins et al (2010) *Predicting the impact of coexistence-guided GM cropping on Irish biodiversity* Final Project Report, Series No 39, STRIVE EPA Programme 2007-2013
http://www.epa.ie/downloads/pubs/research/biodiversity/name_27573.en.html

¹⁴ Ibid

production system aligned with the GM crop will provide the farmer with a greater degree of flexibility in regards to management options.

This issue was highlighted in the UK Farm Scale Evaluation studies completed in 2003 and further investigated in the BRIGHT field based studies in 2004. In contrast, if GM crops were to be introduced into existing non-GM crop regimes it is likely that field biodiversity will decrease as the management options will not have been optimised for the novel GM varieties and their respective traits."

Does GMO cultivation have an impact, and if so which one, regarding:

- **protected or endangered species;**
- **their habitats;**
- **ecologically sensitive areas;**

See answer under 2.2 above. The Teagasc CINMa index has highlighted the potential impact of increased nitrogen use efficiency in crops. The cultivation of such a trait could reduce nitrogen applications by up to 40% significantly reducing Nitrogen runoff into water and air with the consequential benefit of increasing water quality and decreasing oxygen depletion.

Does GMO cultivation have an impact, and if so which one, regarding:

- **migration routes;**
- **ecological corridors;**
- **buffer zones.**

Teagasc felt that, *"the cultivation of GM crops relevant to the Irish tillage sector will have no significant impact on migration routes, ecological corridors or buffer zones."*

As previously stated, farmer groups, organic and conventional farmers and beekeepers all felt that buffer zones, as currently proposed and used, were insufficient for protection purposes.

Does GMO cultivation have an impact, and if so which one, regarding:

- **biodiversity;**
- **flora;**
- **fauna;**
- **landscapes.**

Please refer to section 2.2 above.

Any other impacts you would like to mention:

Teagasc indicated that any modification to farming practice would impact on landscape biodiversity. The introduction of GM varieties will be no different but for the fact that they do provide the opportunity for tillage farmers to increase biodiversity levels within their fields and in the surrounding semi-cultivated habitats.

In your view, could GMO cultivation have an impact (positive or negative) on native plants that may be affected by pesticides and/or on the patterns of use of chemical herbicides?

The EPA noted that currently, under conventional agricultural practices, weeds are already managed by the application of herbicides. The introduction of GM crops might have a positive impact on native plants as it could result in the use of fewer herbicides.

In your view, could GMO cultivation have an impact (positive or negative) on honey bees?

The EPA noted the important role that honeybees play as pollinators for many plants and that if GM crops are grown, bees will certainly come into contact with the GM plants. The Agency felt that the potential impact would need to be determined on a case-by-case basis for the various crop species. The Agency also noted that authorisations of GM crops at EU level will only be granted on the basis of no impact on honeybees.

Teagasc felt that GM crops relevant to Irish agriculture would not pose a risk to native and/or imported bee populations, as the traits in question are not insect targeting;

“The biggest threat to bee populations remains the importation of honey bees, which act as a source of disease for native populations. Separately, the occurrence of ‘Colony Collapse Disorder’ (CCD) in honey bee populations has been extensive across the globe and has resulted in significant reductions in bee numbers along major crop production zones (e.g. USA). However, the perceived linkage between GM crops and CCD seems unlikely when it is noted that states like Illinois, with expansive GM crop acreage have not reported problems with CCD. A more likely explanation is the Israeli acute paralysis virus of bees, which has been strongly correlated with the occurrence of CCD and not the widespread cultivation of the GM insect resistant Bt crops. This is reassuring to all sectors of agriculture, especially the organic sector which utilises lyophilised Bt protein as an insecticide.”

Conversely, the Irish Doctors Environmental Association stated that *“there are many hypotheses as to why we are losing honey bees worldwide. It seems quite reasonable that when environmental elements upon which the bees are dependent are distorted through technology/chemical poisons etc this could well affect their well-being and ability to function properly. In addition to the alterations in the plants, biocides are an obvious environmental addition that could affect bees adversely.”*

The Banner Beekeepers Association felt that, as GMOs generally led to a policy of mono-crops in an area, bees in that area would also have a correspondingly poor diet. They felt that mono-pollen diet was another potential contributing factor to disappearing bees in the US.

For the following sections (2.3, 2.4, and 2.5) much of the text is of a speculative nature, reflecting the fact that the sections in question focus on areas of GM research as opposed to currently marketable GMO products.

2.3 Renewable or non-renewable resources

Does the placing on the market of GMOs have an impact regarding the use of renewable resources (water, soil...)?

The EPA expressed the view that the use of pest and disease resistant GM technology could potentially result in lower amounts of Plant Protection Products usage by farmers. Consequently, this could have a positive impact on both water bodies and soil.

The use of 'bioremediation' (using GM plants or GM micro-organisms) currently being used in the USA and elsewhere to remove toxic pollutants from the environment was cited. Examples include the cleaning up of heavy metals and oil products from contaminated sites. It could be argued that this would have a positive environmental impact.

When cultivating GM HT crops, less weed biomass is produced which in turn could affect the biogeochemical cycles (e.g. the nitrogen cycle) of soils.

In its response, Teagasc highlighted the benefit to current growers of conventional potatoes who must treat their crops every 2-4 days to control potato blight disease. In contrast, GM blight resistant potatoes would require a minimal (< 3) number of applications during the growing season, thereby significantly reducing soil compaction within the fields and decreasing water usage.

Does the placing on the market of GMOs have an impact, if so which ones, regarding the use of non-renewable resources?

The potential impact of GM-crops on both renewable and non-renewable resources is difficult to estimate. It could be argued that energy savings can be achieved by using GM crops through greater use of minimum tillage cultivation which would reduce fuel costs for the farmer. Also, the use of GM IR and GM crops that are tolerant to diseases caused by fungi, bacteria, viruses, nematodes, and other pathogens could result in reduced Plant Protection Product applications that are currently used by Irish farmers to control crop losses,

The possibility exists in the future for GM-technology to produce vegetable oils from biofuels, bio-degradable plastics, and starch from GM potato which would produce more environmentally friendly resources having a reduced environmental impact and a cheaper production cost. This would have a positive impact on both renewable and non-renewable resources. (EPA)

In your view, could GMO cultivation have an impact (positive or negative) on the health and sustainability of the cultivated soil and whether it would be affected by pesticides and/or on the patterns of use of chemical herbicides?

It is the view of the EPA that the use of GM crops to attain the employment of minimum tillage cultivation practices would have a positive impact on the ecological sustainability of tillage soils.

2.4. Climate

Does GMO cultivation have an impact regarding our ability to mitigate (other than by possibly reducing CO₂ emissions from fuel combustion – see next section) and adapt to climate change? If so, which ones?

Agriculture has a big impact on climate change. Emissions from the agriculture sector in Ireland are reported to be 27% of total CO₂ equivalents emissions (EPA 2008). This is higher than in most other EU countries because of the particular importance of the agricultural sector to the Irish economy.

GMO technology can potentially be used to reduce the impact of climate change by the following methods:

- Less fuel consumption on farms through a reduced need to spray crops - the use of minimum tillage reduces the need for tractor usage, less application Plant Protection Products-less spraying required. This could result in lower CO₂ emissions.
- Carbon sequestration, through adopting sustainable management practices, e.g., reducing the amount of ploughing in conventional tillage. Consequently, over time soil quality is enhanced and becomes carbon-enriched since more crop residue can be left on the fields.
- Reduced fertiliser use and N₂O emissions - the use of “Nitrogen Use Efficiency” (NUE) technology which makes crops that require less nitrogen fertiliser because they use it more efficiently. It should be noted that GHG nitrous oxide (N₂O) is a resulting by-product of nitrogen fertiliser application has a global warming potential 296 times greater than CO₂
- Produce crops to improve the climate impact of ruminants, e.g. less methane producing feed crops.
- Climate change might produce ‘emerging’ plant pathogens, e.g. variability of blight fungus populations with earlier infestations of plants.

Irish academic/researcher - David McConnell, Professor of Genetics at Smurfit Institute of Genetics, has also expressed the view that sunlight falling on GMO plants could also play a large part in replacing petrochemicals.

“Solar energy absorbed by GMOs will power the production of bulk foods, modified foods, chemicals, enzymes, fine chemicals (such as amino acids and vitamins), pharmaceuticals, plastics and petrochemical substitutes

GMO technology is already increasing the efficiency of bulk carbohydrates, especially starch, and starch is being converted on a massive scale into glucose, high fructose syrup (isoglucose) and alcohol - all produced from GMO corn. It is also clear that GMOs can be constructed that synthesise petrochemicals or petrochemical substitutes. For example GMOs have been constructed capable of making plastics such as polyhydroxybutyrate and polylactic acid, some of which have the added value that they are biodegradable. Alcohol, produced from plant starches and sugars can of course be a feedstock for the chemical industry

In every case the question is whether the use of GMOs to make chemicals will be economical and that will depend more and more on oil prices, new technology, tax policy etc. GMO plus sunlight is expected to be more energy efficient than factory plus petroleum”.

The Bioindustry Association (IBEC) submission also cited the EPA figures on GHG emissions associated with Irish agriculture.

“The application of artificial fertilisers underpins present tillage management but the GHG nitrous oxide (N₂O) is a resulting by-product of this usage and has a global warming potential 296 times greater than CO₂. Understandably, significant emphasis will be placed on agriculture to share in meeting the EU’s legally binding target for a reduction of 20% in GHG emissions by 2020 (European Commission, 2008), which underlines the importance of developing novel GM crops/crop systems to reduce the tillage sector’s fertiliser requirements

By 2040, temperatures in Ireland are predicted to increase by 1.25–1.5 °C, with rainfall amounts expected to increase by up to 15% in the winter months and decrease by up to 20% over the summer (Intergovernmental Panel on Climate Change, 2007). At a regional level, the principal effects of this change have led to more intense rainfall in the northern and western coasts, with decreases or small increases in the south and east (McElwain & Sweeney, 2007). The viability of potato as a commercial crop in these regions will be very much dependent on the availability of irrigation water to offset drought stress and the degree to which projected rainfall increases in spring and autumn will interfere with sowing and harvesting operations, respectively (Holden et al., 2003).”

Teagasc also felt that biotechnology is the only currently available means with which to deliver low input crops in the timescale that will permit rural communities to respond to the macro challenges (e.g. EU legislation and climate change) facing Irish agriculture.

Conversely, IDEA felt that a move to GM type monoculture created additional danger in a world adapting to Climate Change;

“With climate change an increase in frequency and intensity of extreme weather may stress biodiversity. In order for food sources to be secure we will need to depend on a wide range of robust and diverse species of crops, some of which may survive, even thrive. Monoculture is very prone to failing harvests due to extreme weather or environmental pests that are unforeseen at present.”

2.5. Transport / use of energy

Does the cultivation of EU approved GMOs have an impact regarding energy and fuel needs/consumption? If so, which ones?

The Environmental Protection Agency expressed the view that, *“GM crops could have a positive impact on energy requirements and fuel consumption by using less fuel resulting from minimum tillage cultivation and lower amounts of Plant Protection Products applications”*.

Academic/researcher David McConnell, Prof. of Genetics at Smurfit Institute of Genetics also expressed the view that the cultivation of EU approved GMOs could have a positive impact regarding energy and fuel production by increasing the efficiency of biofuel production.

“There is no doubt whatsoever that GM technology will increase the efficiency of biofuel production (through breeding plants that make starch or sugars more efficiently). We know this because GMO corn is powering the US biofuel industry. It is expected that GM technology will increase the efficiency of all other grains, as well as other sources of starch or sugar, cassava, potato and sugar cane. The current anti-GM policies are inhibiting such research. GM technology will undoubtedly lead to varieties of rape (canola) with higher yields of oil (biodiesel).”

Does the cultivation of EU approved GMOs have an impact regarding the demand for transport in general terms? If so, which ones?

As stated previously, the adoption of GM crops may result in higher costs for the farmer to avoid mixtures of GM and non-GM seed. It may also result in a demand for more specialised forms of transportation.

IDEA pointed out that GMO crops are usually associated with large scale industrial agriculture and often with export markets. These are both highly dependent upon transport.

3 - Other Implications

The EPA has suggested that it might be useful for EU Member States to include an assessment of socio-economic implications before making a decision on whether to approve a GM crop for cultivation. Such an assessment might include the following aspects:

- whether the deliberate release would be a benefit to society;
- whether the deliberate release would be a benefit to sustainable development.

Currently, this is what happens for GMO applications in Norway in accordance with their Gene Technology Act.

Once the scientific opinions are in place it should be left to the normal working of the market to recognise and translate the socio-economic factors through supply and demand. (IGFA)

The lack of inclusion of a stand-alone “human health” category was queried by several respondents, indicating a wish to see separate processes in terms of environmental risk assessment and health risk assessment, as part of the authorisation process.

List of Responses Received

Name of Individual/Association	Category of Respondent
Drew Kershen	Academic, international
Mark Cantley	Academic, international
Professor David McConnell	Academic, Ireland
Professor Charles Spillane	Academic, Ireland
Karen Holt, Syngenta	Agribusiness R&D, international
Aoife Nic Giolla Coda	Agribusiness, Ireland
Robert McGregor	Consumer, international
C. Caulwell	Consumer, Ireland
D. Treya	Consumer, Ireland
C. O'Riordain	Consumer, Ireland
Yvonne Moynihan	Consumer, Ireland
James Duff	Consumer, Ireland
A. Moynan	Consumer, Ireland
E. Hynes	Consumer, Ireland
Bridget Carlin	Consumer, Ireland
Elinor Hitching	Consumer, Ireland
Feidhlim Harty	Consumer, Ireland
Jarlath Reidy	Consumer, Ireland
Ivor Sweeney	Consumer, Ireland
R. Fensome	Consumer, Ireland
Jim Wilson	Farmer, Ireland
John Heney	Farmer, Ireland
Con Trass, Irish Apple Growers Association	Agricultural Representative Association, Ireland
Richard Hackett, Hackett Agricultural Consultants	Agricultural consultant, Ireland
Liam Grogan	Farmer, Ireland
Environmental Protection Agency	Government Agency, Ireland
Teagasc	Government Agency, Ireland
A. Tong	Grower, Ireland
Dr. M. Gillen, IBEC	Agricultural Representative Association Ireland
Richard Murphy, Westmeath Environmental Group	Interest Group/NGO
Leitrim Organic Farmers Co-op	Consumer, Ireland
Con Lucey	Consumer, Ireland
Donal O'Leary, Macroom District Environmental Group	Interest Group/NGO
F& J Duff, Irish Doctors for the Environment	Interest Group/NGO
Dr. Ruth McGrath, Voice of Irish Concern for the Environment	Interest Group/NGO
Deirdre Webb, IGFA Grain Committee	Grain Merchants/Industry Representative

	Association
Cullen Allen, Cully & Sully	Food Producer, Ireland
Eoin Keane	Farmer, Ireland
T. Miller	Farmer, Ireland
B. McSwiney	Farmer, Ireland
Stella Coffey	Farmer, Ireland
John McDonnell	Farmer, Ireland
Michael Murphy	Farmer, Ireland
Niamh Ní Dhúill	Farmer, Ireland
Grace Maher	Farmer, Ireland
Natasha Harty	Farmer, Ireland
John Brennan	Farmer, Ireland
Nick Cullen	Farmer, Ireland
MC Barrett	Consumer, Ireland
Patrick Treacy	Consumer, Ireland
Agricultural Science Association	Agricultural Representative Association and Professional Body, Ireland
Kathy Marsh, Sonairte: The National Ecology Centre	Interest Group/NGO
Gillian Westbrook, Irish Cattle and Sheep Farmers Association	Agricultural Representative Association