Consultation on the Socio-economic Implications
of the placing on the market of GMOs for cultivation

Invitation to Comment

Teagasc Response starts on Page 7.

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

Introduction:

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. However, the Commission has now deemed it an appropriate time to look at the need for such an assessment and particularly so in light of fact that the consideration of socio-economic factors in the authorisation of GMOs for cultivation has been raised by several EU Member States in recent months[1]. The Commission has therefore invited Member States to submit all information they would consider relevant so as to initiate an analysis of socio-economic implications.

With a view to framing an appropriate response the Department of the Environment, Heritage and Local Government is now seeking observations on the socio-economic impacts of the placing on the market of Genetically Modified Organisms for cultivation.

Information received in response to this consultation process will help in formulating the report from Ireland to the European Commission on this subject.

This document contains an overview of GMOs and the relevant legislation. A questionnaire is included to focus and facilitate commentary on socio-economic topics of particular importance. However respondents can also include their observations on additional topics they consider relevant.

Comments should be submitted by email or by post to the address below by 24th February 2010. Comments received may be made available publicly on the Department's website.

by email: environmentpolicy@environ.ie

by post: Environment Policy Section,
Department of the Environment, Heritage and Local Government,
Custom House,
Dublin 1.

[1] Environment Council of 2 March 2009, Agriculture Council of 23 March 2009 and Environment Council of 25 June 2009

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

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 genetically modified organisms (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 Directive 2003/29/EC 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 98/81/EC amending 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);
- 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).

Further information on the EU regulatory framework on GMOs is available from the European Union website http://www.europa.eu.int/: or by visiting the GMO section of this site.

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 GMOs.

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 this Directive.

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

- The contained use of Genetically Modified Organisms
- The deliberate release of Genetically Modified Organisms into the environment
- The transboundary movement of Genetically Modified Organisms

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 and Food is responsible for:

- Regulating seed for cultivation
- Regulating animal feed that contains or is derived from GMO
- Developing a national strategy to ensure the co-existence of GM crops with other crops
- Licensing of pesticides for use on crops including GM crops.

Questionnaire Instructions:

This consultation document utilizes a questionnaire format to focus and facilitate commentary on the potential socio-economic implications of the placing on the market of GMOs. However, space is given to allow respondents to include observations on additional topics they consider relevant.

Respondents will potentially find some sections of the questionnaire more relevant than others, depending on the nature of their interest in this subject. It is therefore not necessary to complete all sections of the questionnaire. Respondents can omit sections which do not apply and can also expand on areas of relevance.

The questionnaire is 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 are asked to include contact details and to indicate the nature of their interest in this consultation process.

Respondent Details

Name/Organisation: Teagasc
Ireland's Agriculture and Food Development Authority

Contact Number: 059 9170200

and/or

Email Address: Frank.omara@teagasc.ie

Nature of Interest : Teagasc is the Agriculture and Food Development Authority in Ireland. Its mission is to support science-based innovation in the agri-food sector and the broader bioeconomy so as to underpin profitability, competitiveness and sustainability. Teagasc has been researching both from a socio-economic and environmental context the potential impacts of GMO cultivation for over 10 years. The deliverables from this publicly funded research conclude that a select number of GM crops, which are suited to the Irish agri-environment will present a distinct economic benefit to rural societies and upon integration into a GM – specific crop management system have the potential to deliver increased levels of biodiversity.

If employed in/representing the Agriculture sector or a related sector, it would be particularly helpful if you could indicate if you are working in, or representing, any of the following sub- sectors :

✓	Farmer(s) cultivating conventional crops;
✓	and/or organic crops;
✓	beekeepers;
✓	seed producers producing conventional seeds;
✓	seed producers producing organic seeds;
✓	plant breeders;
X	multiplying companies;
✓	seed producing farmers;
X	seed distributors;

Other potential relevant entries include:

✓	Consumers;
X	Cooperatives and grain handling company;
✓	Food and feed industry;
X	Transport companies;
X	Insurance companies;
✓	Laboratories;
✓	Innovation and research;
✓	Public administration.
✓	Economist

Completing this section will enable a complete analysis of the impacts of GMO cultivation on different sectors of the economy.

1 - Economic and social implications:

In your view, would GMO cultivation have economic and/or social impacts? Please explain your view. (*Note that included impacts can be positive or negative. A list of potential topics, broken down by sector, is included in the Appendix of this document for consideration. However the list is not definitive or exhaustive.*)

The globalisation of agricultural commodities coupled with the requirement to farm in a more sustainable manner underscores the necessity for Irish farmers to continue to integrate technological advances into their production systems. Failure to do so will undermine competitiveness and disadvantage Irish farmer's ability to provide products and services as or more effectively and efficiently than their relevant competitors.

First introduced in 1996, the rate of GMO cultivation across the world continues to increase year-on-year[2] and inevitably GM technologies will be deployed for most major crops in the future[3]. For the Irish tillage sector, the potential for GM varieties to increase / maintain overall competitiveness will be critical to farmer's decision to adopt/reject GM technology.

Presently, no GM crops are cultivated in Ireland because the current suite of GM varieties is not suited to the Irish environment. The crops with the biggest potential for genetic modification in Ireland are those grown on a large scale, namely barley, wheat, oilseed rape and maize and/or currently receive very high applications of pesticides and fertilisers (e.g. potato)[4]. Several of these crops are in advanced trials across the European Union[5]. Research conducted by Teagasc indicates that their future introduction into Ireland will have a positive economic impact on tillage systems[6] and provide the opportunity to increase levels of biodiversity within the agri-environment[7]

The likely early adopters of GM technology in Ireland will be specialist farmers with large farm acreage and who have formal agricultural education[8]. This cohort represents the most efficient, high end demographic within the tillage sector that will be eager to comparatively assess the efficacy of their existing conventional varieties against those GM crops most suited to the Irish agri-environment.

Those GM varieties include:

- Herbicide tolerant oilseed rape and maize
- Late blight resistant potato

[2] See http://www.isaaa.org

[3] Tester, M and Langridge, P. (2010). Breeding Technologies to Increase Crop Production in a Changing World. Science, Vol. 327, 818, DOI: 10.1126/science.1183700.

[4] 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.

[5] See http://gmoinfo.jrc.ec.europa.eu/

[6] Flannery, M-L., Thorne, F., Kelly, P. and Mullins, E. (2004). An Economic Cost-Benefit Analysis of GM Crop Cultivation: An Irish Case Study, Journal of Agrobiotechnology Management and Economics, 7(4), 149-157.

[7] Mullins et al. (2010). Predicting the impact of coexistence-guided GM cropping on Irish biodiversity. Final Project Report, Series No. 39, STRIVE Environmental Protection Agency Programme 2007-2013. http://www.epa.ie/downloads/pubs/research/biodiversity/name,27573,en.html

[8] Keelan, C., Thorne, F., Flanagan, P., Newman, C. and Mullins, E. (2010). Predicted Willingness of Irish Farmers to Adopt GM Technology. Journal of Agrobiotechnology Management and Economics (in press).

- Fungal resistant (against Septoria and Fusarium disease) wheat
- Nitrogen use efficient wheat, barley, potato and oilseed rape[9].

For blight resistant potato alone, the net benefit to the grower would be in excess of €198/ha[10]. The subsequent benefit for the other crops listed will vary between farmers and will be dependent upon the crop management regimes they will be obliged to adopt[11].

It is clear from our research that the primary reason farmers will choose GM crops over conventional varieties is due to the potential of GM varieties to generate additional income and/or increase the available time for the farmer to perform ancillary tasks. As each of the above listed crops will meet one/both of these criteria, it is pragmatic to assume that once these crops become available within the EU a number of Irish farmers will seek to grow them.

While it is incorrect to assume that GM varieties will yield significantly more than current conventional varieties, Irish-specific research concludes that the income potential of the early adopters of GM varieties will increase. Despite farmers having to incur additional costs related to coexistence compliance, the financial benefit will manifest through reduced production costs (e.g. reduced spray applications, decreased diesel and depreciation costs) and increased labour flexibility[4].

As existing production systems are heavily reliant on chemical protectants to ensure an economic viability, the imposition of the new EU pesticide regulations will force farmers to seek alternatives. At present, biotechnology is the only 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.

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[9] 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.

[10] Flannery, M-L., Thorne, F., Kelly, P. and Mullins, E. (2004). An Economic Cost-Benefit Analysis of GM Crop Cultivation: An Irish Case Study, Journal of Agrobiotechnology Management and Economics, 7(4), 149-157.

[11] http://www.agriculture.gov.ie/gm_coexistence/

In your view, could 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.

Owing to the costs of producing certified seed, 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.

Critically, the provision of GM seed does 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[12]. 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.

2. - Agronomic sustainability

2.1 Agricultural inputs

In your view, would the cultivation of GMOs which are approved for cultivation in the EU have an impact (positive or negative) regarding the use of pesticides against target insect pests?

To date, the sole GM variety approved for cultivation in Europe remains *Bt* corn. Designed to confer resistance to the European Corn Borer this pest is not resident in Ireland, hence the lack of *Bt* maize cultivation here. In this context, its consideration in this report is not warranted. However, it can be expected 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[13]. This question (2.1) is most relevant to disease resistant potato and wheat, the cultivation of which will have

[12] http://www.agriculture.gov.ie/gm_coexistence/

[13] 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.

a positive impact regarding the 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 GM varieties.

In your view, could the placing on the market of GMOs have an impact (positive or negative) regarding the use of pesticides or/and on the patterns of use of chemical herbicides?

Following on from the previous question, the answer is 'yes'; the placing on the market of specific GM varieties and their subsequent adoption by Irish farmers will deliver a reduction in the use of pesticides and/or on the patterns of use of chemical herbicides[14].

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 [15]

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)

In your view, would the cultivation of EU approved GMOs have an impact (positive or negative) regarding the number of non agriculture species/varieties?

Intensive, conventional farming has had a negative impact on wild species and habitats and land use change continues to place a high stress on local and national biodiversity[16]. The final report from a recently completed project (funded by the Environmenetal Protection Agency) highlights the potential for specific GM varieties to impact positively on biodiversity levels across the Irish agri-environment[17].

[14] 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.

[15] 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.

[16] Discussed in O'Brien, M. et al. (2008). An insight into the impact of arable farming on Irish biodiversity: a scarcity of studies hinders a rigorous assessment. Biology and Environment, Proceedings of the Royal Irish Academy, Vol. 108B, No. 2, p.97 – 108.

[17] Mullins et al. (2010). Predicting the impact of coexistence-guided GM cropping on Irish biodiversity. Final Project Report, Series No. 39, STRIVE Environmental Protection Agency Programme 2007-2013. http://www.epa.ie/downloads/pubs/research/biodiversity/name,27573,en.html

To assess 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
- Management impacts.

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

In short, the described methodology identified areas where biodiversity is likely to be negatively or positively impacted, as well as agricultural zones which may benefit from the land use change associated with GM crop management. More specifically, CINMa indicated that:

- For GM NUE oilseed rape there may be additional biodiversity stress applied to semi-natural areas but that the overall benefit from altered management and lower nutrient inputs will have a positive effect on the wider landscape.
- For GM HT oilseed rape a modest potential benefit for soil organisms was recorded due to the adoption of an optimal management for this GM trait. There were no chemical concerns in marginal habitats, soils or watercourses due to the lower toxicity of glyphosate compared to existing chemistries.
- For GMHT maize a positive impact on levels of biodiversity would be recorded. Again it is in the area of management that the benefits accrue as well as in-field weed diversity due to a more flexible regime for spray applications.
- For GMLBR potatoes, a positive benefit was recorded due to the reduction in field traffic and resulting soil compaction arising from reduced pesticide applications.
- For GMNUE potatoes a similar result was returned with special note taken by the potential of this crop to promote diversity within semi-natural habitats.

For each of the above listed crops there is significant potential to increase soil quality[18]. This must be seen as a positive step since soil biodiversity, especially agricultural soils, has significant economic consequences at a local and global level.

In your view, could GMO cultivation have an impact (positive or negative) on agriculture diversity (number of plant varieties available, agriculture species, etc?)

[18] Mullins et al. (2010). Predicting the impact of coexistence-guided GM cropping on Irish biodiversity. Final Project Report, Series No. 39, STRIVE Environmental Protection Agency Programme 2007-2013. http://www.epa.ie/downloads/pubs/research/biodiversity/name,27573,en.html

Continuing on from the previous question, the CINMa index was designed to take into account the impact of GM crops on both the managed environment of the field, along with semi-natural (e.g. hedgerows, roadsides etc…) and natural areas.

To summarise; the cultivation of specific GM crops will impact positively on agricultural biodiversity. Not because of the crop itself but because the 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[19] and further investigated in the BRIGHT field based studies in 2004[20]. 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.

In your view, could GMO cultivation have an impact (positive or negative), regarding:
- protected or endangered species;
- their habitats;
- ecologically sensitive areas;

GM cropping will exert a positive impact, albeit indirectly, on ecologically sensitive areas and hence protected species due to the reduction in chemical protectants that would accompany the cultivation of specific GM crops in Ireland. In particular, the CINMa index has highlighted the potential impact of increased nitrogen use efficiency in crops[21]. The cultivation of such a trait could reduce nitrogen applications by up to 40% (in oilseed rape[22]), significantly reducing N runoff into water and air with the consequential benefit of increasing water quality and decreasing oxygen depletion.

In your view, could GMO cultivation have an impact (positive or negative) regarding:
- migration routes;
- ecological corridors;
- buffer zones.

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

[19] Firbank, L. (2003). The Farm Scale Evaluations of spring-sown genetically modified crops. Philosophical Transactions of the Royal Society, Biological Sciences, Vol. 358, No. 1439, p. 1777.
[20] Sweet et al. (2004). Botanical Rotational Implications of GMHT in winter oilseed rape and sugar beet. Kenilworth, HGCA.
[21] Mullins et al. (2010). Predicting the impact of coexistence-guided GM cropping on Irish biodiversity. Final Project Report, Series No. 39, STRIVE Environmental Protection Agency Programme 2007-2013. http://www.epa.ie/downloads/pubs/research/biodiversity/name,27573,en.html)
[22] Good A.G., Johnson S.J., De Pauw M., Carroll R.T., Savidov N., Vidmar J., Lu Z., Taylor G., Stroeher V. (2007). Engineering nitrogen use efficiency with alanine aminotransferase. Canadian Journal of Botany, 85, 252–262.

In your view, could GMO cultivation have an impact (positive or negative) regarding:

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

Any other impacts (positive or negative) you would like to mention:

Any modification to farming practise will 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[23]

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?

See previous points.

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

Those GM crops relevant to Irish agriculture will 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[24]. 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[25]. A more likely explanation is the Israeli acute paralysis virus of bees, which has been strongly correlated with the occurrence of CCD[26] 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.

[23] Mullins et al. (2010). Predicting the impact of coexistence-guided GM cropping on Irish biodiversity. Final Project Report, Series No. 39, STRIVE Environmental Protection Agency Programme 2007-2013. http://www.epa.ie/downloads/pubs/research/biodiversity/name,27573,en.html)

[24] See: http://www.teagasc.ie/publications/tresearch/tresearch200705.pdf

[25] Oldroyd BP (2007) What's Killing American Honey Bees? PLoS Biol 5(6): e168. doi:10.1371/journal.pbio.0050168

[26] Cox-Foster et al. (2007). A Metagenomic Survey of Microbes in Honey Bee Colony Collapse Disorder. Science, Vol. 318, No. 5848, pp. 283-287.

2.3. Renewable or non-renewable resources

In your view, could the placing on the market of GMOs have an impact (positive or negative) regarding the use of renewable resources (e.g water, soil)?

Research[27] indicates that specific GM crops will impact positively on the use of renewable resources. This would be particularly relevant to GM blight resistant potato. Current growers of conventional potatoes 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.

In your view, could the placing on the market of GMOs have an impact, (positive or negative) regarding the use of non-renewable resources?

The placing on the market of those GM crops currently in the development pipeline will decrease the use of non-renewable sources (e.g. diesel/petrol) as a result of a reduction in the number of spray applications (see above point on GM blight resistant potato).

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?

Research indicates that the cultivation of certain GM crops (e.g. HT maize) will not impose a negative impact on soil microbial populations compared to conventional maize systems[28]. For those GM crops that have the potential to replace crops that require high treatment numbers (e.g. Septoria resistance winter wheat, blight control in potato), it can be anticipated that soil quality will be improved due to reduced compaction and disturbance[26].

2.4. Climate

In your view, could GMO cultivation have an impact (positive or negative) regarding our ability to mitigate (other than by possibly reducing CO^2 emissions from fuel combustion – This is covered in section 2.5) and adapt to climate change?

[27] Mullins et al. (2010). Predicting the impact of coexistence-guided GM cropping on Irish biodiversity. Final Project Report, Series No. 39, STRIVE Environmental Protection Agency Programme 2007-2013. http://www.epa.ie/downloads/pubs/research/biodiversity/name,27573,en.html

[28] Griffiths, B. et al. (2008). Soil microbial and faunal responses to HT maize and herbicide in two soils. Plant and Soil, 308, 93-103.

The relevance of specific GM crops in light of the challenges facing Irish and European landscapes is real [29]. For example, the cultivation of herbicide tolerant crops in conjunction with minimum tillage has the potential to reduce CO_2 emissions from otherwise ploughed soil, therefore impacting positively on our ability to mitigate climate change. Only 4% of arable land in Ireland is established by minimum tillage methods, yet minimum tillage systems have a reduced fuel demand at approximately 50% of that of the plough-based system[30]. In addition, with reduced soil disturbance, more carbon remains in the soil and therefore less CO_2 is released to the atmosphere. In parallel, GM crops present a positive avenue for our ability to adapt to climate change, which will see farmer's crops experiencing increased abiotic and / or biotic stress levels. The emergences of these stresses will out pace the development (through conventional means) of varieties with appropriate resistance mechanisms. In contrast, GM technology provides an opportunity to develop varieties across a much shorter time frame[31].

2.5. Transport / use of energy

In your view, could the cultivation of EU approved GMOs have an impact (positive or negative) regarding energy and fuel needs/consumption? If so, which ones?

Specific GM crops, that are alternatives to those conventional crops which require multiple treatments, will exert a positive impact regarding energy and fuel needs/consumption. As stated previously, conventional potato crops receive an average of 15 chemical treatments per growing season, while cereal growers spray a minimum of 3 times during the crop's lifetime. In contrast, disease resistant potato and wheat varieties will significantly reduce fuel consumption and subsequent CO_2 emissions. For GMHT crops, the impact on fuel consumption would be negligible as HT crops still require an herbicide application, similar to conventional systems. However, the adoption of HT in parallel to minimal tillage presents the opportunity to further reduce CO_2 emissions from cultivated soils (see earlier).

Separately, GM technology provides the opportunity to tailor existing crops to increase their biofuel potential. For example, GM maize has been produced to convert the lignocellulose rich stover into bioethanol via the introduction of biomass conversion enzymes into maize germplasm so the conversion process (post-harvest) can be completed more effectively[32]. Although, it is unlikely that such a GM maize sector could develop without significant downstream investment in indigenous refinery capacity, GM technology does provide significant potential for future biofuel production in Ireland.

[29] 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.309-323.

[30] Forristal, D. (2008). The effect of minimum tillage on the production of spring barley and oilseed rape and an assessment on its impact on soil characteristics and soil fauna. Teagasc Crops Research Centre, End of Project Report, RMIS No. 5615.

[31] Wendt, T. and Mullins, E. (2010). Future challenges and prospects. In: Potato Genomics (Ed. J. Bradeen), Springer, in press.

[32] Torney F., Moeller L., Scarpa A., Wang K. (2007) Genetic engineering approaches to improve bioethanol production from maize. Current Opinion in Biotechnology, 18, 193–199.

In your view, could the cultivation of EU approved GMOs have an impact (positive or negative) regarding the demand for transport in general terms? If so, which ones?

See previous points, noting that those GM crops that provide the farmer with the opportunity for reduced spraying (e.g. disease resistant varieties) will impact positively on the demand for transport.

3 - Other Implications

If you wish to submit any additional comments, please use the space below.

Arising from the strategic funding programmes of the Department of Agriculture, Food and Fisheries and the Environmental Protection Agency, Teagasc has committed significant resources into a multi-disciplinary research programme tasked with quantifying the potential socio-economic impact cultivating GMOs in Ireland. This publicly funded initiative has delivered an impartial perspective on an otherwise polarised debate. This is most relevant in the context of the provision of high protein feed as a critical requirement for the Irish beef, pig and poultry sectors, with over 1Mt of GM feed (soya and maize products) imported annually. The EC Directorate-general for agriculture and rural development predict[33] that the cost of substituting non-GM maize products for GM maize products could be as high as €60/tonne for some Member States with direct sea access (Spain, UK, Portugal, Netherlands and Ireland). It is likely that a similar price differential would be seen if Ireland was excluded from producing GM cereals while other EU member states adopt the technology. From a national context, the consequence of substituting GM feedstocks with imported non-GM feed are significant; negatively impacting on the dairy sector by up to €17.7 million and the beef sector by up to €18.6 million[34]. Such additional costs might be sufficient to make even these extensive livestock industries uncompetitive internationally. The adoption of a GM-free approach to animal feedstuffs would also impact on the pig and poultry sectors which rely heavily on the use of GM feed in the animal's diet. Indeed, it is highly unlikely that the Irish pig and poultry industries, in particular, could survive this without a premium being paid for GM-free meat, as the history of recovering such premiums from the market place has not been a positive one[35]. In order to fully capitalise on research delivered to date, Teagasc foresee the

[33] European commission, Directorate-general for agriculture and rural development. (2007). Economic impact of unapproved GMOs on EU feed imports and livestock production. http://ec.europa.eu/agriculture/envir/gmo/economic_impactGMOs_en.pdf.

[34] Thorne, F.S., Hanarahan, K. and Mullins, E. (2005). The economic evaluation of a GM free country: an Irish case study. RERC Working Paper Series 05-WP-RE-08. http://www.agresearch.teagasc.ie/rerc/downloads/workingpapers/05wpre08.pdf

[35] Lawlor, P. and Walsh, M. (2009). The GM debate and the Irish pig meat sector. T-Research 4:(4)26-27.

necessity for continued investment in the area of assessing the relevance and impact of GM technology to the Irish agricultural sector. To this end specific research must be conducted to ensure that;

- GM-specific management systems are delivered to guarantee the genetic integrity of organic crops while not curtailing the right of conventional farmers to grow specific GM varieties with the potential to increase their competitiveness.
- the longevity and viability of introduced GM traits is prioritised in order to deliver to GM farmers a pragmatic crop management system for each GM crop.
- each GM crop management system is fully optimised to ensure there is a neutral/postive impact on biodiversity levels compared to equivalent conventional systems of cultivating specific GMOs

To conclude, there is substantial evidence to indicate that the absence of GM cropping will ensure Ireland is distinctly disadvantaged, both from a socio-economic and environmental context. It is correct to state that not all GM varieties will out-perform their conventional equivalents. In this case, farmers will choose existing crops and systems over those generated through GM technologies. In contrast, certain GM traits will present a distinct economic benefit to rural societies and if managed correctly will lead to increases in biodiversity within the Irish agri-environment.

All of the research described here has been publicly funded and is available for review on www.gmoInfo.ie

Thank you for participating in this consultation.