5.1.2010

ANNEX 1

QUESTIONNAIRE about the socio-economic implications of the placing on the market of GMOs for cultivation

16 July 2009

A – Introduction note

Article 31.7 (d) of Directive 2001/18/EC[1] provides that the Commission should send to the European Parliament and the Council a specific report on the operation of the Directive including inter alia an assessment of the socio-economic implications of deliberate releases and placing on the market of GMOs. These implications are defined in Recital (62) of the Directive as the socio-economic advantages and disadvantages of each category of GMOs authorised for placing on the market, which take due account of the interest of farmers and consumers. In its 2004 report, the Commission noted that there was no sufficient experience to make such an assessment (the Directive became fully applicable as of 17 October 2002 and several Member States had not transposed yet so only little experience of its implementation was available).

Moreover Regulation (EC) No 1829/2003, its articles 7 and 19, asks the Commission to submit a draft of the authorisation decision taking into account, together with the opinion of the Authority in charge of the scientific assessment, "other legitimate factors relevant to the matter under consideration".

At its meeting on 4 December 2008, the Environment Council adopted conclusions on GMOs mentioning among other things the appraisal of socio-economic benefits and risks of placing GMOs on the European market for cultivation. In particular the Council conclusions indicated the following:

"The Council:

7. Points out that under Regulation 1829/2003 it is possible, under certain conditions and as part of a case by case examination, for legitimate factors specific to the GMO assessed to be taken into account in the risk management process which follows the risk assessment. The risk assessment takes account of the environment and human and animal health. Points out that under Directive 2001/18/EC, the Commission is to submit a specific report on the implementation of the Directive, including an assessment, inter alia, of socio-economic implications of deliberate releases and placing on the market of GMO.

   Invites the Member States to collect and exchange relevant information on socio-economic implications of the placing on the market of GMOs including socio-economic benefits and risks and agronomic sustainability, by January 2010. INVITES the Commission to submit to the European Parliament and to the Council the report based information provided by the Member States by June 2010 for due consideration and further discussions.

[1] Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC

This possible consideration of socio-economic factors in the authorisation of GMOs for cultivation has also been raised by several Member States in the Environment and Agriculture Councils of the last months[2].

In order to respond to the invitation of the Council conclusions of 4 December 2008 and to the requirements of the legislation, the Commission invites Member States to submit all information they would consider relevant by January 2010 at the very latest.

In order to help Member States in structuring their responses, the Commission drafted a non exhaustive list of areas and stakeholders which could be concerned. In addition, for each of these categories, we have introduced in the annex a list of leading questions which could be used where considered appropriate.

When preparing their contribution Member States are invited to report *ex post* on the socio-economic impact of GMOs that have been approved in the EU and cultivated in their territory. Additionally, Member States are also invited to assess *ex ante* the possible implications of GMOs of currently pending approvals as well as those which are under development according to the best of their knowledge. One possible source of information in that respect is that recent report produced by the Joint Research Centre titled "The global pipeline of new GM crops" (available at http://ipts.jrc.ec.europa.eu**).**
The submissions must be as explicit and informative as possible and supported by evidence and data. When feasible, the socio-economic analysis – be it *ex post* or *ex ante* – should be quantified. In case documents are attached, they should be accompanied by a summary of the relevant part and a specification about the argument or topic that is being defended.

Where stakeholders are consulted at national level (e.g. farmers and consumers), we would appreciate it if their responses would be incorporated in your submission in an aggregated fashion. The list of stakeholders consulted, as well as any other pertinent information, may indeed be attached to the questionnaire.

Please note that the contributions must only deal with "socio-economic implications of the placing on the market of GMOs including socio-economic benefits and risks and agronomic sustainability" for each category of GMOs. These contributions should cover cultivation of GMOs and placing on the market of GM seeds.

If you choose to fill in the annexed questionnaire, please consider that answers should be broken down by the purpose of the genetic modification (herbicide tolerant, insect resistance, etc) if this affects the content of the responses.

DEADLINE FOR CONTRIBUTIONS: January 2010

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

B - Contact Details

Member State: Finland

Name of ministry/ies contact Person/s: Ministry of Social Affairs and Health / Irma Salovuori

Contact Address: Kirkkokatu 14, Box 33, 00023 Government, Finland

Telephone: +358-9-16001 **Fax**: +358-9-160 73876

E-mail Address irma.salovuori@stm.fi

C – 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

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Lead questions per area and stakeholder

For each question, answers should be broken down:
- by the purpose of the genetic modification if this affects the content of the responses,
- between ex ante and ex post considerations.

1. - Economic and social implications

Upstream

1.1. Farmers

For each question, answers can be broken down by the range of relevant agricultural stakeholders farmers

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

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

- farmers' revenues (output prices and agricultural yields);
- farmers' production costs;
- labour flexibility;
- quality of the harvest (e.g.mycotoxines);
- cost of alternative pest and/or weed control programmes;
- price discrimination between GM and non-GM harvest;
- availability of seeds and seed prices;
- dependence on the seed industry;
- farmers' privilege (as established by Article 14 of Regulation (EC) No 2100/94 on Community plant variety rights) to use farm-saved seeds;
- the use of agriculture inputs: plant protection products, fertilisers, water and energy resources;
- 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;
- conflicts between neighbouring farmers or between farmers and other neighbours
- labour allocation- insurance obligations;
- opportunities to sell the harvest due to labelling;

- communication or organisation between the farmers;
- farmer training;
- beekeeping industry.

MTT Agrifood Research Finland:

Grower incomes: GMO application of higher starch content of industrial potatoes, which is supposed to be translated into higher income of growers – unless costs related to GM-potatoes, particularly those concerning coexistence with non-GM potatoes do not mitigate such income benefits.

Cropping practices: GM starch potato is unlikely to cause substantial changes in aggregation of potato production, because coexistence issues with non-GM potato crops should be negligible. Potato produces very little pollen and reproduces vegetatively by way of tubers, thus coexistence issues are likely to be solved with reasonable coexistence measures.

Conflicts with neighbouring farmers or other neighbours: Such conflict may arise due to opposition to GM crops in general by some groups in the society. Such conflicts are not necessarily brought into the open, however, when the other party is a grower. For example, in Spain Binimelis (2008) has shown that organic growers, after their fields were contaminated with GM crops, did not always sue the neighbouring grower who was responsible (albeit not purposefully) for the contamination. The organic growers valued harmonious relations with their neighbouring growers more highly than suing them to get compensation. Cultural differences may, however, have an influence on how keenly liability issues are brought into open via official channels when there is a justified reason to do so. See also Vänninen et al. 2009 for farmer typologies in respect to acceptance of GM crops and conflicts that may arise because of acceptance differences.

Beekeeping: Producers of organic honey are worried even about potential contamination of honey by pollen of GM potato. This in spite of the fact that bees (*Apis mellifera*) do not much visit potato flowers, because the flowers lack cues that would attract bees (Samford & Hanneman 1981). They may visit potato flowers if nothing else is available (see Malone & Delègue 2001 and references therein). Based on the above references, it seems highly unlikely that cultivation of GM potato would affect production of organic honey (assuming of course that the GM trait does not in any way influence quality of flowers so that they would be more attractive to bees than usually).

The Finnish Union of Organic Farming:

Farmers cultivating conventional crops;

The discussion on GMOs has often been mainly associated with organic production, even if the threats involved concern conventional farming very much in the same way. As a result of GMO cultivation the conventional farmers also lose the opportunity to produce safe foodstuff. The competitive advantage of Finnish agriculture in the future rests with GMO-free products, also in conventional farming. As yet no genetically modified plants are cultivated in Finland and we still have the chance to choose GMO-free production as the backbone of our agriculture. From the social and economic perspective, genetic modification is an equally serious threat for all production sectors and production practices in rural areas.

Farmers and beekeepers cultivating organic crops;

The Union of Organic Farming proposes that Finland should stay a GMO-free country. The legislation must ensure that the preconditions continue to exist for organic production also in the future. GMO cultivation calls for equitable and fact-based research which all stakeholders can rely on. Independent researchers stress that the risk assessment of GMO foods and feeds has not yet advanced to a level that would mean that the cultivation of GMOs could be supported without taking risks. Experiences have shown that preventing the unintended spread of pollen and seed of GMO plants is impossible in practice. Wild hybrids which have escaped to the nature have made it impossible to continue organic farming and increased the costs of other farmers as well. As regards gene technology, Finland should choose the path of contained use for research and keep the Finnish nature free from all GMO material, this maintaining the competitiveness of Finnish food production and the ability to respond to future climate, nutrition and energy policy challenges.

Finnish Beekeepers Association:
For beekeeping industry the increase in GM-plant production is a problem by many ways. The first problem is legislation.

GM-plant that are nor registered for human use can not be used as human food. Bees collect effectively pollen from GM-plants in 3 km radius from the hives. If there are non-food GM plants within this radius, it is very likely that GM-plant pollen can be found in honey. This kind of honey is not accepted for sale to humans. This has already caused withdrawal of honey and financial losses to beekeepers in Germany. Because of this all pollen and nectar producing GM-plants entering the market must be accepted as human food. This also increases consumer safety.

Another forthcoming legislation problem is right to produce. In Finland we have several commercial organic beekeepers. In the EU rules the production area for organic honey can not include GM-plants within 3 km of hives. A professional beekeeper with 30 apiaries has this way a collection area of 848 square kilometres. If farmers start to use GM-plants in this area the beekeeper must stop production or change place. If several farmers in the area go for GM-plant production the organic beekeepers lose their whole profession. Who has the right to continue his production, organic beekeeper who has been in the area for 10 years, or farmer going to GM-plant production? Just to be able to avoid GMO-fields the beekeepers must have free access to information of places where GM-plants are grown.

Besides legislation problems GM-plants can affect bees and other pollinators. Several GM-plants are tailored to be resistant to pests by the poisonous chemicals these plants produce. These plants can also affect pollinators that relay on pollen and nectar as their main diet. Some GM-plants produce sterile pollen whose nutritional value is low. Pollinators can not detect this and they may collect inferior food for themselves. All this can cause problems and financial losses for beekeepers trying to keep their bees in good health. Lack of pollinators is already causing financial losses to farmers. Increase in pollination problems will increase price of production costs for farmers too. New GM-plants coming into production must be tested for effects to bees and their brood.

Finnish Food and Drink Industries´ Federation:
There will be an impact on the following:
- farmers' revenues (output prices and agricultural yields);
- price discrimination between GM and non-GM harvest;
- availability of seeds and seed prices;
- dependence on the seed industry;

- farming practices, such as coexistence measures and clustering of GMO and/or non-GMO production;
- cost of coexistence measures;
- conflicts between neighbouring farmers or between farmers and other neighbours;
- opportunities to sell the harvest due to labelling;
- beekeeping industry.

Professor in Microbiology/University of Helsinki:
There will be an impact on the following:
- farming practices, such as coexistence measures and clustering of GMO and/or non-GMO production; Organic farmers worry already.
- cost of coexistence measures can be a problem for farmers cultivating GM crops.
- conflicts between neighbouring farmers or between farmers and other neighbours can be a problem for farmers cultivating GM crops; organic farmers worry already.
- beekeeping industry: Could be a problem for beekeepers, if activists are active.

Any other impacts you would like to mention:

Finnish Environment Institute:
has generated a heuristic understanding for studying the social dimensions embedded in GM plants. The starting point is that outside laboratories a plant can have an intermediating role only as a cultivar; as something which has integrated into biological processes and human practices. The actual stabilizing entity is thus not just an object, but a dynamic analogous to what is called a developmental system. The empowering or suppressing consequences of GM plants depend significantly on the qualities of this spatio-temporal order stabilizing; on the "possibility space" it opens up. Moreover, stabilization connects and makes things possible, but it does not do so automatically or predictably. In this process, humans and their practices must adjust too. The study points that the vulnerability of a cultivation technology lies largely in the processes and patterns crucial for dynamic stability. (Valve, H. 2008. GM plants as sources of im/possibility – a developmental systems view of stabilization. *New Genetics and Society* 27(4): 339-352.)

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.

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.

Any other impact you would like to mention:

Seed Traders Association:

Plant breeders

- Benefits:

New traits via GM in existing varieties may boost the use of certified seed.
New traits via GM may boost breeding of new varieties.

- Obstacles:

Limited access of conventional breeding companies to GM breeding technology may lead to business concentration.
Owners of GM-technology in breeding can dictate which varieties are available as GM.

Seed multiplication

- Benefits:

The use of certified seed will grow. There will be more business in seed multiplication.

- Obstacles:

Rules on segregation of production of GM seed from the conventional seed (legislation on co-existence) will mean an additional challenge to have enough farmers and acreage for seed production as a whole.
The seed producers, who produce GM seeds will actually be tied to production of GM seeds. There is in short term no way back to conventional seed.

Seed distributors

- Benefits:

Increased volume through increased percentage of use of certified seed

- Obstacles:

Challenges to logistics (seed warehousing, processing, packaging, treatment)
Small and medium size seed distributors will have to compete with multinationals which are vertically integrated (breeding, multiplication, distribution)

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);

The Finnish Consumer's Association:

GMO cultivation could have an impact on consumer choice if better quality and a larger diversity of products could be produced by the technique. At the moment this has not been the case. Consumers need to get a clear benefit of using GMO-products.

- the price of the goods;

The Finnish Consumer's Association:

One of the arguments on behalf of GM-production is that the technique could allow lower prices for goods. According to the EU Biotechnology Barometer in 2006, only 12 % of the respondents would definitely buy GMO-products if they were cheaper than the traditionally produced ones. So the price might not be a good enough reason for the consumers to use GMO-products.

- consumer information and protection;

The Finnish Consumer's Association:

Consumers must have a chance to make an informed decision. This means clear on pack information of genetic modification. Adequate information is a question of consumer protections as well.

Finnish Forest Research Institute:

The knowledge needed or wanted by the consumer is highly dependent on the defined genetically modified application.

The Finnish Union of Organic Farming:

We wish to remind that even if the consumers wish for cheaper foods, they do not want them at any cost. According to Eurobarometer of 2007 survey, 72% of the Finns who responded had a negative attitude to GMO products. The majority of the European consumers were against GMO agriculture. The consumers have good reasons to be concerned about the health and environmental risks involved. The opinion of the consumers, representing the market forces, must be taken very seriously.

Finnish Food and Drink Industries´ Federation:

There will be an impact on the consumer information and protection.

Professor in Microbiology/University of Helsinki:

There will be an impact on the price of the goods. If GM products are cheaper, many consumers will buy them.

Any other impact you would like to mention:

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.

Finnish Food and Drink Industries´ Federation:
There will be an impact on the following:
- handling and storage;
- transport.

Professor in Microbiology/University of Helsinki:
There will be an impact on the following:
- handling and storage can be a problem.
- transport: Logistics can be a problem.

Any other impact you would like to mention:

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;

Finnish Food and Drink Industries´ Federation:
There will be an impact on the following:
- range of products on offer;
- crop handling (drying, storage, transport, processing, etc...).

Any other impact you would like to mention:
Professor in Microbiology/University of Helsinki:
Food and feed industry buy where they can get commodities cheap; in case GM is more expensive they won't use it.

1.6. Transport companies

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

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?

The Finnish Union of Organic Farming:
The fact that no insurance company in the world has agreed to offer insurance policies to farmers to cover GMO risks and damages tells a great deal about the risks involved in genetic modification. The risks are simply too great or fully unknown, because it has been impossible to design insurance policies to cover them.

1.8. Laboratories

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

- employment, turn over, profits;

Finnish Forest Research Institute:

Potentially increased number of controlling authorities and testing laboratories, changes in the knowledge needed by the authorities and persons working in the testing laboratories.

- feasibility of analyses;
- time necessary to provide the results;
- prices of the analyses.

Finnish Forest Research Institute:

Technologies are becoming available for all laboratories and thus basic analyses performed become relatively cheap. If possible to consider high-throughput analyses prices may even go down.

Any other impact you would like to mention:

Finnish Forest Research Institute:

The use of GM-plants allows the continuous improving of genetic transformation technology. For example, technologies allow targeting at more specific integration sites.

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);

Finnish Forest Research Institute:

It is difficult to know. Now it is relatively difficult to get money for research concerning GM-plants, because there are no GM-plants cultivated in Finland.

- investment in research in minor crops;

Finnish Forest Research Institute:

There is definitely need for more specific understanding on several plant species. In most cases even the natural variation is not known. However, in reality funding of the research concerning minor crops may decrease.

Professor in Microbiology/University of Helsinki:

Hopefully yes.

- employment in the R&D centres in the EU;
- use of non-GM modern breeding techniques (e.g. identification of molecular markers);

Finnish Forest Research Institute:

So far there are no signs on the increased use of molecular markers as a result of the cultivation of GM-plants.

Professor in Microbiology/University of Helsinki:

Hopefully yes.

- access to genetic resources;
- access to new knowledge (molecular markers, use of new varieties in breeding programmes, etc.).

Professor in Microbiology/University of Helsinki:

Hopefully yes.

MTT Agrifood Research Finland:
Assuming GM crops become in wider use, investments in plant production research are likely to be increased, because it is also in public interests to study something that is widely used and presents both benefits and risks to the society. Many of the techniques used in the research of GM crops (for example, genetic markers and their application for diagnostics) are also applicable to non-GM crops, thus their more open availability would benefit also research and its applications to non-GM crops.

Research of GM crops' and its benefits and risks in the EU countries is lagging behind research in the US and South America, because due to the restrictions on their use in the EU similar things cannot be studied here than is possible in the latter countries. This opinion was expressed, for example, by the convenor of the IOBC working group "GMOs in Integrated Plant Production" Jürg Romeis at the General Assembly meeting of IOBC in 2009 in Agadir, Moroccco, October 3rd 2009.

As to research on plant protection, which is one of the major goals of the first generation GM crops, more interest should be placed on integrated approached to plant protection instead of narrow one-solution approaches. Public research would be in better position to address more complex plant protection solutions that need to be integrated with such novel crops as Bt-maize or cotton. Public research is not as strongly as private research influenced by strong commercial interests aiming at increasing sales and acreage of GM crop solutions, thus it would be in better position to study the use of integrated pest management in the context of using GM crops. Wider use of GM crops is likely to increase public research in such more complex issues, adding diversity to research questions and sustainable use of GM crops.

Ministry of Agriculture and Forestry/Dept. Of General Affairs/Research Unit:
The experience of Finland in the 90s show that the expectations to the use of plant biotechnology significantly increased investment in plant research both in the public and private sector. However, in the longer term the impact of biotechnology especially in the private sector remained low in Finland and elsewhere in Europe. A major reason for this was a general negative attitude of Europeans to GM crops and foods. Also the long development phase of GM plant products reduced the interest in the field after initial enthusiasm of the investors. Development is now reflected in the reduction of investment in plant biotechnology research also in the public sector, with the exception of funding of basic research.

Rapid development of genomics and the other closely related -omics techniques, have especially in Europe compensated the effects of unpopularity of genetic modification, particularly in plant breeding. The aim is to change the properties of plants by strengthening the endogenous traits of plants by genetic modification and thereby avoid the transfer of foreign genes in plants. This type of development could have a beneficial impact to the development of legislation and public acceptance of technology. The future, however, will show the extent to which this development will eventually replace the 'traditional' genetic modification in case the EU's GM policy is not forthcoming changes in the coming years.

The use of genetic modification in plant research and breeding has not affected the availability of crop genetic resources in Europe. The availability of genetic resources for breeding also in the future is particularly important now, when our crop varieties have to be adapted to new environmental conditions as a result of climate change. Special feature of genetic resources of traditional varieties is a good adaptability to different environments in which they have been long cultivated. The availability of genetic resources in the future is a prerequisite for Finland both for traditional breeding and GM-based breeding, because we cannot simply replace our crop varieties under cultivation by varieties presently under cultivation in other regions.

Professor in Agroecology/University of Helsinki:
It is important that the IPR measures do not lead to the injustices in seed trade and seed propagation or to the farmers e.g. through an unintended mixture of seeds.

Professor in Plant Breeding/University of Helsinki:
The trend in plant breeding research has moved from the enthusiasm in 1980's to a more reserved attitude nowadays. For example, only a few projects in the Finnish universities have targeted to solve practical problems for a long time (vs. cold tolerance, molecular breeding of malt barley, flowers etc. earlier). The development of virus resistant GM plants is one of the few subjects which still have existed.

Nevertheless, GMOs have not been as negative matter in Finnish basic research (or strategic research) as in many other European countries (e.g in the UK). The feasibility of GM technology in research has not been questioned and therefore the know-how has persisted in this area.

If GM cultivation becomes common (also in Finland), it could be thought that the projects directed to applications become realistic again as well as the investments of the firms in the R&D of GMOs. Then the IPR matters in the universities would also become active after the low season of 15 years. Personally I would support a somehow more transparent IPR policy. For example, the IT sector has not patented the tools but the products (e.g. the programmes).

The modern non-GMO breeding is possible through then know-how in genetic engineering, which might indicate stimulation in that research field as well.

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

Finnish Environment Institute:
A need for a national enforcement policy, new quidelines, additional labour and other implementation costs, enhanced collaboration between different stakeholders.

Professor in Microbiology/University of Helsinki:
It should have.

Any other impact you would like to mention:

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:

MTT Agrifood Research Finland:
Main concern, which is likely to affect all farms, is the availability of suitable GM varieties. Many of the crop varieties grown in Finland have been traditionally bred there, owing to the fact that the large global biotechnological firms do not set out to solely develop varieties intended for Finland's boreal climate and small markets. These varieties have to be developed either as a result of domestic research and development work, or by purchasing genes and GM plants from foreign companies for use in domestic plant breeding (Niemi et al. 2003). Therefore, the role of the public sector in making suitable varieties available is considered very important for the Finnish market. If the public sector will not assist in this, and farmers are expected to be active in the acquisition of suitable seed, smaller farms would probably suffer most. Larger farms have more resources for the acquisition of seed, even from outside Finland. On the other hand, due to high transportation costs and other practical problems, the acquisition of GM seed from abroad is not necessarily a tempting alternative.

The main advantages offered to farmers by GM technology would be the agronomic gains. Such benefits come in the form of yield increases, cost reductions in pest management, improved risk management and insurance against pests etc. Potato farming would also become technically easier. The advantages are therefore considerable. On the other hand, studies (for example, Hillyer 1999) have shown that there are signs that contract production might become too restrictive from the farmer's point of view. In Finland, however, there is no evidence of circumstances where the autonomy of farmers has been weakened considerably as a result of contract production. It should be noted, however, that with the exception of the malt and starch industry contract production is relatively rare in Finland.

Overall, the interviewees were somewhat in disagreement as to the effects of gene technology on the status (e.g. autonomy) of the farmer. It was not seen as a realistic scenario that farmers would end up in a position where they are "crofters" in the service of large companies, but it was considered possible that there would be some decrease in autonomy. Some maintain that contracts erode a tradition of farmer independence in production decisions and management. On the other hand, others argue that contracts are likely to offer premiums over average market prices for agricultural commodities, greater access to new technology and inputs, and new sources of capital.

Finnish Food and Drink Industries´ Federation:
It probably provokes cross-border investment flows (including relocation of economic activity).

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;

Professor in Microbiology/University of Helsinki:

Perhaps local impacts.

- farms' size;
- the farm production practices (e.g. increase or decrease of monoculture);
- the reputation regarding other commercial activities of the region/localities.

Professor in Microbiology/University of Helsinki:

Organic farmers worry about this, but it might be the opposite – they will do better nationwide.

Any other impact you would like to mention:

MTT Agrifood Research Finland:

As far as potato is concerned, the adoption of gene technology on smaller farms would not seem to pose a problem. There are several reasons for this. First, gene technologies available today are relatively inexpensive. All that one needs is to invest in new seeds and pesticides. Copyright fees and royalties for these items will increase, of course, but not so much as to have a significant effect on the rate of adoption of new innovations. Additional costs might of course emerge, if the construction of separate storage buildings or such is necessary, but costs will be low to start with.

If the isolation requirements call for cultivation rotation, the farm's business becomes non-profitable. The requirement of even one year of keep from cultivating potato when moving from GM potato to regular (non-GM) potato farming renders farming unprofitable during the transition year in an average-size (37.50 hectares) full-time farm. One year of keep from cultivating potato, during which time cereal is cultivated on the parcel, increases the production cost of food potato by ¢8.58 (24.9%) (ranging from ¢4,53 to ¢11,37 per kg) in monoculture if the supplemental potato seed is cultivated on the farm. In other words, if a farmer cultivates GM potato and then changes to non-GM potato after one year of pause, during which time the farmer has cultivated cereal on the parcel, the production cost of food potato is ¢8.58 higher during the first potato cultivating year than it would be without the one-year pause. But there is no cultivation rotation requirement if the farmer always continues to cultivate GM potato in the same field that had GM potato in the preceding year.
The cultivation rotation requirement makes it more difficult for farmers to move from GM to non-GM potato, as the cost of production during the first year of non-GM potato farming rises too high. This would result in a competitive advantage that continuing cultivates GM potato. On the other hand, awareness of sunk costs and uncertainty (or risk) of the costs incurred may prevent farmers from adopting GM potato in the first place.

Because of cultivation rotation and border strip requirements, farmers will need to give up potato cultivation in fields where they have carried out potato-monoculture. As potato production is often concentrated near the farm houses, the deployment of new fields contributes to transportation costs.

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)?

Finnish Environment Institute:
Potato varieties resistant to potato blight, if approved for cultivation, have the potential to decrease use of chemical fungicides. There is a possibility that the potato blight may overcome the defence effect of the GM-potato.

Professor in Microbiology/University of Helsinki:
Probably yes, but for other pests no.

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?

MTT Agrifood Research Finland:
The production cost of seed potato production is an average 47.80 ¢/kg. In 1998–2003, the Plant Production Inspection Centre inspected 2,235 seed potato lots for viruses. Of these, five lots (0.2%) were rejected due to the A and Y viruses, and in 61 lots (2.7%) the seed potato was degraded to a lower seed grade. Virus risks have increased the cost of production of seed potato by an average of 1.7%.

During the last two years, the situation has rapidly changed. In 2005, a total of seven lots (2.7%) were rejected for virus content and 49 lots (19.2%) were downgraded to a lower seed class. In 2005, the virus risks increased the cost of seed potato production by 13.3%. In 2006, the virus situation appears to be even worse: more than half of the tested potatoes had the virus, of which 85% was the Y virus and the rest the A virus. 10 seed potato crops were rejected because of the virus, totalling approximately 56 hectares (3.2%), and the seed class has been lowered on every third plantation. In 2006, the virus risks increased the cost of seed potato production by 17.8%.

A GM variety that can reduce the long-term problems of potato viruses would decrease the cost of production of seed potato. During the review period of 1998–2003, the virus risks of viruses spread by plant-lice increased the cost of production of seed potato by an average of €226/ha. In other words, if it were possible to completely eliminate the virus risks with a GM variety, it could reduce the cost of production of seed potato by € 226/hectare and increase the profitability of seed potato production by the same amount if the beneficiary were the seed potato producer alone. If the beneficiary was the seed potato buyer, the food potato producer, the seed cost would lover by € 34.49 per planted food potato hectare. If the beneficiary was the refiner of the seed potato, it could collect an additional 1.45 ¢/kg of variety royalty, and if the beneficiary were the variety representative, the price of the base seed could be € 226 higher per planted seed potato hectare. In other words, the price of the base seed potato could be approximately 6 ¢/kg higher.

There are constantly new mycoses for the potato, and the potato's resistance to mycoses has proven a difficult objective in plant biotechnology (Lorito et al. 1998). Late blight (Phytophtora infestans) resistance in plants is not a monogenetic but a polygenetic feature. Therefore perfect late blight resistance is more difficult to attain than perfect virus resistance. If gene technology could be used to even partially lower the use of pesticides in fighting the late blight, it would, however, be of higher economic significance than in virus-based disease prevention. Late blight prevention along with its labour cost causes an average cost of €184 per hectare annually for the seed potato producer, which increases the price of seed potato by two percent. In food potato production, late blight prevention causes an approximate production cost of €148, which amounts to 1.8 percent of the production cost, while in starch potato production the cost is €77, or 3.5 per-cent of the production cost.

The black scurf black scurf (rhizoctonia - rhizoctonia solani) has also been an increasing problem in potato production. It is possible to fight it by covering the potato seed (by disinfect). The cost of disinfect with the labour and capital expenses is approximately €0.04 per potato kilogram. In practice, all seed potato producers disinfect their own base seed. That notwithstanding, two percent of the inspected seed potato was rejected to reduced to a lower seed class because of the black scurf and stem canker in seed potato population inspection. This risk factor causes an annual hectare expense of €522 to the seed potato producer, which increases the price of seed potato by 3.9 percent.

The most significant bacterial potato diseases are bacterial ring rot (clavibacter michiganensis subsp. sepedonicus) and black leg (erwinia carotovora). The bacterial ring rot is classified as a dangerous plant disease, and the farmer is obliged to notify plant protection authorities of its occurrence. The prevention and risks of bacterial ring rot causes an annual expense of more than €100,000 in seed potato production alone. This increases the price of seed potato by 0.6 percent. Although the black leg has not been classified as a dangerous plant disease, its prevention causes even higher costs than the prevention of bacterial ring rot. In seed potato production alone, the prevention and risks of the black leg increase the production cost of a seed potato hectare by €636 annually, resulting in 4.8 percent price increase for seed potato.

The potato's herbicide tolerance, primarily the glyphosate tolerance, has been one of the most studied topics in gene technology research. In weed prevention, gene technology will not result in great cost savings in the short term, as the herbicides only change from other herbicides to glyphosates. On the other hand, the effect of the glyphosate may be better than that of other plant protection agents, and the optimal injection time is better in the Finnish conditions than with other protection agents. Furthermore, the use of glyphosate may, in the long run, permanently reduce the population of certain weeds in the field, whereby the use of plant protection agents can be reduced.

The pests' resistance is an area that has gained wide attention among researchers. The resistance of the golden nematode has been studied in several EU projects (NONEMA) (Hofvander 2003). Monsanto has refined a potato variety in 1995 to resist the Colorado beetle. However, some researchers are sceptical about the potential of gene technology against the Colorado beetle. The United States spend an approximate of $350 per hectare to fight the Colorado beetle along (Thill 2003, see also Heikkilä and Peltola 2003). If the

Colorado beetle could spread in Finland and could fully winter in Finland, it would mean an annual cost of €10 million to the society

Plant protection alone and the risks caused by weeds, plant diseases and pests along with the labour and capital cost cause an additional expense of €1,582 per hectare in seed potato production. This increases the price of seed potato by 13 percent. In food potato production, the cost of plant protection is €498, which amounts to 5.7 percent of the production cost.

Finnish Environment Institute:
There is a possibility for reduced use of herbicides when cultivating herbicide resistant sugar beet. However, it depends on the cultivation practises. GM-plants approved so far (maize) cannot be cultivated in Finland due to cold climate. On the other hand, the cultivation of herbicide-resistant rapeseed may increase the amount of herbicides used.

Sugarbeet Research Center:
The socio-economic impact of the GMO Sugar beet in Finland

During the years 1998-2000 the GMO sugar beets were part of the trial program of Sugar Beet Research Center in Finland. The trials in Finland included two herbicide tolerant (HT) varieties. One variety from Hilleshög AB, from Sweden (Roundup Ready variety), and the second from AgroEvo AG from Germany (Liberty Link variety). Since these were the only two varieties, the following statements will concentrate only to the HT varieties.

In Finland the GMO testing trial program included both the variety testing and the herbicide trials. In the variety testing the HT varieties were compared to the common varieties within the yield and quality measurements. HT varieties had lower yields and quality compared to the common varieties during the testing period. However, the quality development of these varieties was just on beginning and the breeders could have been able to increase the quality within 3 to 5 years time. Comparing the weed management between common and HT varieties revealed that HT varieties had clearly more efficient weed control programs. There were differences also between two HT varieties. Roundup Ready variety had more efficient program than Liberty Link.

Economical summary of weed control on common vs. HT varieties

In 2009 the basic (annual weeds) weed control cost of common sugar beet farming in Finland was between 150 €/ha and 200 €/ha. Additionally to this basic weed control, also the perennial weeds need they own shear. The estimated cost for perennial weeds would be around 65 €/ha. The work cost of sprayings will increase the total costs by 108 €/ha. In 2009 estimated total cost for sugar beet weed management was between 320 €/ha and 360€/ha.

The experiences from the HT variety trials indicated that use of glyphosate (360 g glyphosate/l) would be efficient way of controlling both annual and perennial weeds. With 2 to 3 sprayings of glyphosate (3-6 l/ha per time) would be efficient enough to terminate all annual and perennial weeds. If the spraying doses were reduced to 1 l/ha some of the annual weeds were not totally killed.

The calculations of glyphosate costs for sugar beet showed that the 2 to 3 spraying programs costs would be around 48 €/ha to 75 €/ha. In this calculation the price of glyphostae is estimated to be around 6.70 €/l and the work costs approximately 54 €/ha. The conclusion would be that the savings for farmer in weed control with the HT variety would be around 270 €/ha to 290 €/ha.

Using the information from USA, there would be an additional technical fee added to the price of HT varieties. This fee would be approximately around 40 to 45 €/ unit (60 $). If this technical fee would be added to the total weed control costs it would increase the final costs to the 88-120 €/ha, however still leaving it clearly below the costs of common sugar beet weed control costs.

Sociological summary of HT sugar beet

During the testing program between 1998 and 2000 the risks and benefits of the HT varieties could be considered.

The benefits:
- The result of the weed control with the HT varieties would be more reliable at the moment compared to the common system.
- The weed control of the HT varieties would be more flexible than the common system. The timing would not be as critical as it is now. Also the news from USA has indicated that farmers are willing to pay extra money just to ensure the flexibility and the reliability of the sprayings.
- Even though glyphosate is not a low use rate herbicide it is considered to be a low risk herbicide in terms of toxicity and environmental effects.
- The use of HT varieties would reduce the use of tractor on fields and it would have positive impact on fossil fuel use and soil compaction and overall have the positive contribution to global warming.
- The crop rotation between HT sugar beet varieties and cereals would easily reduce the problems with perennial weeds on crop rotation.
- Because of small sugar beet growing areas in Finland the number of herbicides is limited and difficult to diversify. HT varieties could partly solve this problem.
- The sugar beet growers in Finland are ready to start using HT varieties if the consumers and industry are willing to accept the GMO.

The risks:
- Wide use of glyphosate will probably totally cut of the other herbicides from the market.
- Weeds evolve resistance to herbicides and this process is accelerated when they are used year after year.
- The genes conferring herbicide resistance to the crop can move to weedy relatives (wild sugar beet) by out crossing and causing a more problematic weed development.
- In case of out crossing farmers are beginning to apply other herbicides with glyphosate, if there is any, and that will increase the use of total mount of herbicides.
- Also the development of the wild beet on sugar beet farming is high risk and farmers should mechanically harvest all the wild flowering beets from the field, which is time and labor concerning job.

Conclusion:

In the context of the agronomical development the GMO sugar beet and other GMO farm crops are valuable step. This step could offer us possibility to reduce the rate of harmful herbicide use. However, the risks and benefits are very geography- and time –dependent. Therefore it would be extremely important to realize and make good evaluations for minimizing the environmental risk on Finnish sugar beet growing. The more efficient crop rotation would be valuable criteria to take in use together with GMO crops.

Professor in Microbiology/University of Helsinki:
The use of herbicides will increase, since they are also necessary for no-tillage farming.

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?

Finnish Environment Institute:
There will probably be fewer weeds within the fields and field margins when cultivating herbicide resistant cultivars. Some weeds may have aesthetical values, such as e.g. cornflower. The cultivation of herbicide resistant sugar beet can also diminish the number of bees and butterflies due to diminished quantity and diversity of weeds (especially dicot or broadleaved weeds). Moreover, weed seeds are important feed for many birds.

Professor in Microbiology/University of Helsinki:
If large scale, yes.

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

Finnish Environment Institute:
If a GM-plant will be cultivated in a large scale, it may reduce the use of e.g. local cultivars or the use of farmer's own seeds that will in turn diminish agricultural biodiversity.

Does GMO cultivation have an impact, and if so which one, regarding:
- protected or endangered species; the decrease of weed seed will affect birds,

Finnish Environment Institute:
The following additional aspects should also be included in the assessment:
- skylark, corncrake, ortolan and red-backed shrike
- their habitats; biodiversity of field margins will decrease
- ecologically sensitive areas; leaching of glyfosate may affect ground water areas

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

Finnish Environment Institute:
The following additional aspects should also be included in the assessment:
- migration routes; Possibly. E.g. birds feeding on weed seeds. Butterflies dependent of dicot weeds.
- ecological corridors; Possibly and especially if there will be GMO cultivation in a

large scale. For example the cultivation of herbicide tolerant sugar beet or rape may diminish the number of broadleaved weeds, which are important source of food for bees and butterflies. That will in turn cause fragmentation of habitats and populations.
- buffer zones.

Does GMO cultivation have an impact, and if so which one, regarding:
- biodiversity; **Finnish Environment Institute**: see above.
- flora;. **Finnish Environment Institute:** see above
- fauna; **Finnish Environment Institute:** see above.
- landscapes. **Finnish Environment Institute:** Yes, especially if there will be GMO cultivation in a large scale.

Any other impacts you would like to mention:

MTT Agrifood Research Finland:
The potato is a crop that reproduces asexually by means of tubers. The genetic flow from the potato to its relatives in Finland is highly unlikely. Close relatives that occur in Finland are the black nightshade (solanum nigrum) and bitter nightshade (solanum dulcamara). The possibility of crossbreeding the potato and either of the nightshades has been studied by manually pollinating between the species. Despite attempts, crossbreeding has not succeeded and seeds have not been formed (Eijlander & Stiekema 1994). Therefore the spreading of genetic modifications of the potato by weeds in Finland appears almost impossible based on the studies.

Tuomisto and Huitu (2008; 2006) have study the needs for border strips and cultivation rotation on potato cultivation in Finland. The research data in this study is comprised of four different materials: Map data from the GIS location information system, the field-map information register of the Ministry of Agriculture and Forestry's information management centre (TIKE), the Finnish Food Safety Authority (Evira) protocols and the profitability monitoring of farms with profitability accounting.

Food potato and starch potato patches are not inspected with the exclusion of random tests for dangerous plant diseases. The inspections for seed potato production provide, however, indications of how many for-eign varieties have been found on potato patches in the vegetation inspections. In this case, isolation distances to patches where another variety is cultivated and the impact of cultivation rotation on the germinability of residual tubers are considered.

In 1998–2004, the Evira inspected 2,524 seed potato patches, totalling 9,203 hectares. A total of 1,262,500 tubers to be inspected were collected from that area. Foreign varieties were detected in 256 tubers, or 0.006% of the inspected volume (without " statistical outlier", where is found 180 tubers of foreign varieties in one farm).

By means of the inspection material of Evira we can carry out the correlation between distance of two potato field and the presence of foreign varieties in fields with a distance of 20 metres or less. A non-parametrical Spearman correlation coefficient has been calculated for this correlation. The correlation coefficient is very small (-0.03) and does not have statistical significance (p=0.15). This indicates that no statistically significant connection between the distance and presence of foreign varieties can be detected. Neither has the cultivation history of previous years (0.05) nor the size of fields (-0.06) had statistically significant impact on whether foreign varieties could be found on potato fields.

Table 1. Eviras inspection data 1998-2004

		Certified seed	Basic seed
Data			
	Inspection area (hectares)	9 203	3 139
	Inspection fields (samples)	2 524	1 225
	Number of plants inspected (quantity)	1 262 000	612 500
Result			
	Foreign varieties (number)	256	233
	% of totals	0,020 %	0,038 %
	- Outlier (180 foreign varieties in one farm)	76	53
	% of total (without outlier)	0,006 %	0,009 %
	Number of the fields, that contained foreign varieties (guantity)	50	37
	in which potato had been farmed on the year before (same variety) (quantity)	10	2
	in which potato had been farmed three years before (possibly different variety) (quantity)	35	31
	Average distance of fields (meter)	56,4	25,0
	Average size of potato fields (hectare)	3,65	2,56

In 1998–2004, KTTK inspected 153.8 million kg of seed potato as warehouse inspections. A total of 2.6 million tubers were collected for inspection. Their total weight was 147 tonnes, which amounts to 0.096% of the total. Only 9 occurrences of the incorrect variety were detected in the inspection (0.0001%). Conclusion: there were practically no warehouse and variety mix-ups or the inspectors could not distinguish the wrong varieties.

Tuomisto and Huitu (2008; 2006) assess by their study, how the shape, size and distance to other potato fields affect the need for border strips around potato fields, and what are the effects of this on production costs. As factors affecting costs is considered the proportion, number and type of GM varieties in certain area, climate, shape of fields, crop rotation, structure of farmland ownership, and landscape structure. They assess this by means of a GIS analysis. Each farm has a different field configuration, determined by the neighbouring fields and surrounding landscape. The pattern of ownership may be such that co-operation between farmers is needed to provide a feasible solution. With GIS is taken these different factors into account, and optimize the location of GM and non-GM potato fields so that the costs of co-existence are minimized.

In food potato production, the problem is monoculture and the concentration of cultivation on a small area, although it should be noted that seed potato production is even more concentrated from the area perspective. The production cost of food potato is ¢25.93/kg (ranging from ¢25.21 to ¢30.31 per kg) in monoculture when the additional seed is produced on the same farm.

The need for border strips varies regionally. In areas with lower proportion of potato production, with regular-shaped fields and natural border strips around the potato fields, the need for in-field border strips is lesser. In the Southern Ostrobothnia region where potato production is more concentrated, the need for border strips is greater, which generates more costs for the farmers. For example, a 5-metre border strip in Northern Ostrobothnia (High Grage area) would cause an average ¢0,07 per kg (¢0.05–¢0.35 per kg) additional cost per potato-kg while the additional cost in the Southern South-Ostrobothnia region would be ¢0.17 (1.4%) (¢0.12–¢0,51 per kg).

If the isolation requirements call for cultivation rotation, the farm's business becomes non-profitable. The requirement of even one year of keep from cultivating potato when moving from GM potato to regular (non-GM) potato farming renders farming unprofitable during the transition year in an average-size (37.50 hectares) full-time farm. One year of keep from cultivating potato, during which time cereal is cultivated on the parcel, increases the production cost of food potato by ¢8.58 (24.9%) (¢4.53–¢11.37 per kg) in monoculture if the supplemental potato seed is cultivated on the farm. In other words, if a farmer cultivates GM potato and then changes to non-GM potato after one year of pause, during which time the farmer has cultivated cereal on the parcel, the production cost of food potato is ¢8.58 higher during the first potato cultivating year than it would be without the one-year pause.

Because of cultivation rotation and border strip requirements, farmers will need to give up potato cultivation in fields where they have carried out potato-monoculture. As potato production is often concentrated near the farmhouses, the deployment of new fields contributes to transportation costs. If potato were to be cultivated at the same distance as other plants in average, it would increase the cost of potato production by ¢0.15 per kg (0.6%) (¢0.1–¢0.48/kg).

A border strip of 5 metres is expensive to implement for farmers. If a border strip requirement is imposed on a farmer that cultivates GM potato, the costs are attributed to the GM-potato-producing party. This would cause a competitive advantage to farmers that cultivate non-GM potatoes. It would be worth considering whether the same result could be attained with a smaller border strip, considering particularly Eviras inspection material, which indicates that no statistically significant connection between the distance and presence of foreign varieties can be detected. Neither has the cultivation history of previous years nor the size of fields had statistically significant impact on whether foreign varieties could be found on potato fields.

There is no cultivation rotation requirement if the farmer always continues to cultivate GM potato in the same field that had GM potato in the preceding year. However, if the farmer wishes to cultivate non-GM potato on the field after GM potato, a potato-free year must occur on between the potato types. Even one-year cultivation rotation requirement after GM potato is expensive to implement for farmers. It would lead to a situation where it would no longer be economically profitable for farmers to revert to cultivating non-GM potato in a parcel after GM potato has been cultivated. This would result in a competitive advantage for continuing GM potato cultivation. On the other hand, awareness of sunk costs and uncertainty (or risk) of the costs incurred may prevent farmers from adopting GM potato in the first place.

Increasing the cultivation rotation forces the farmers to cultivate potato on fields further away from the farmhouses. This increases transportation costs. Potato production is characterised, by transportations of greater harvests than in crop cultivation and by several pesticide sprayings during the growth season. This is one of the reasons contributing to the concentration of potato cultivation in the proximity of the farmhouses.

Ministry of Agriculture and Forestry/Dept. Of General Affairs/Research Unit:
Experience from countries where GM crops has been grown on a large scale, is that the use of genetic modification has led to narrowing of the range of varieties under cultivation due to the high developing costs. Because of high costs only a few plant-breeding organizations have had capacity to develop GM crops. Therefore only a few profitable varieties have captured the field. The patenting of GM crops has strenghtend this trend, and therefore revision of the criteria of pantentability of GM plants should be considered for broadening of the genetic base of crop varieties under cultivation.

On the one hand the progress of biotechnology research, including genetic modification, has also contributed to the conservation and sustainable use of agrobiodiversity. Biotechnology has made possible deeper analysis of plant genetic resources and their improved use for plant breeding. For this reason ex-situ conservation of genetic resources (gene banks) has received considerable attention and also financial support. Unfortunately though, this has not reflected in in situ conservation on farm.

2.3. Renewable or non-renewable resources

Does the placing on the market of GMOs have an impact, if so which ones, regarding the use of renewable resources (water, soil…)?

Finnish Environment Institute:
Crop rotation in potato and sugar beet cultivation has not been widely practised due to concentration of cultivation to specific areas in Finland. This will also be true for transgenic cultivation. When cultivating herbicide-resistant cultivars less weed biomass is produced, which in turn affect the biogeochemical cycles of soil.

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

Finnish Environment Institute:
Potential cultivation of transgenic potatoes may hinder/complicate crop rotation and by so doing increase the demand for fertilisers produced with non-renewable resources. If the number of e.g. Bt- resistant pests or herbicide tolerant weeds will increase due to GM-cultivation, the use of pesticides and herbicides may increase.

Ministry of Agriculture and Forestry/Dept. Of General Affairs/Research Unit:
The efficiency of the use of field and forest biomass can be improved both by plant breeding based on new genetic know-how as well as by boosting the efficiency of production processes. With the help of biotechnology and genetic modification, the use of biomass for energy production and for the production of materials can be promoted by developing new *non-food* applications for raw material production for industrial purposes.

Agricultural production, in accordance with the principle of sustainable development, requires efficient prevention of the negative environmental impacts of modern agricultural practices and land use, particularly those due to emissions of nutrient and plant protection products, erosion and habitat fragmentation. Genetically modified crop varieties and related agricultural practices have already shown their efficiency in the reduction of chemical loading and erosion of agricultural environments in countries in which the use of genetically modified crops is widespread. Crop yields can also be improved with the help of genetic modification, which improves the efficiency of agricultural land use and thus fewer natural environments are cleared for agricultural use.

Any other impacts you would like to mention:

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?

Finnish Environment Institute:
E.g. climate change allows moving potato production northwards and thus enhances the importance of Finland as potato producer. However, at the same time climate change intensifies the variability of blight virus populations and makes appearance of infections earlier. The effectiveness of fungicides may be under threat, too. Blight resistant GM varieties would thus act as an adaptation measure. Climate change may also allow rapeseed production northwards (however, GM-rapeseed is not yet approved).

Any other impacts you would like to mention:

MTT Agrifood Research Finland:
Climate: Climate change will increase the number of crop species and crop yields with time (Peltonen-Sainio et al. 2009, in press). However several adaptation measures are needed to realize the expected agricultural benefits of climate change in our conditions. Cultivars bred particularly in conditions where higher temperatures are combined with long daylengths are needed. GM techniques are likely to speed up such selection programs and solutions on national level. Currently available GM crops and cultivars are not compatible with the changing climatic conditions of high latitudes.

Ministry of Agriculture and Forestry/Dept. Of General Affairs/Research Unit:
Finnish crop production is predicted to benefit from climate change. Effects of climate change will require, however, that we have to change many of our varieties through breeding to fit the new environmental conditions. This is because of the uniqueness of the light conditions during the Finnish growing season. This means that we cannot substitute our varieties by imported varieties. Due to the rapid progression of the climate change breeding must be done within a short time. Genetic modification can be used to speed up plant breeding and, therefore, the use of genetic engineering can play a significant role when Finnish plant production is adapted to climate change.
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The Finnish Union of Organic Farming:
An extensive study on the recycling of nutrients in agriculture in the catchment are of the Baltic Sea (Baltic Ecological Recycling Agriculture and Society BERAS) examined the possibilities to improve the state of the Baltic Sea. If all eight states around the Baltic Sea started to cultivate using the production practice where nutrients are recycled prevailing in organic production, this would have very tangible results in terms of the Baltic Sea.
This would lead to a 48% reduction in the nitrogen surplus of the Baltic Sea and there would be no phosphorus surplus at all. This kind of decrease in runoff could be realised without any reduction in the agricultural production volumes of these states from the current level.
Allowing GMO cultivation in Finland would mean that the possibility to continue organic farming will be lost, together with the opportunity to improve the state of the Baltic Sea as described in the report.

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?

Finnish Environment Institute:
Potential cultivation of transgenic potatoes may concentrate potato production further. Small-scale producers may loose in the competition against those who use the new technology and avoid e.g. fungicide costs. This may increase the length of food chains. On the other hand, as a source of distinction, GM production may also support the visibility of e.g. organic farming, which may benefit from its status as an alternative mode of production.

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

The Finnish Union of Organic Farming:
Special attention needs to be directed to the transport of genetically modified material, because international experience has shown that transporting has a particularly significant role in the harmful spread and admixture of genetically modified plants. Transport of genetically modified material involves a high socioeconomic risk, which is why very strict requirements should be imposed for transport.:

Any other impacts you would like to mention:

3 - Other Implications

The Finnish Union of Organic Farming:
The main achievements of genetic manipulation in the past ten years are the glyphosate tolerant crops and a gene that produces insect-killing Bt toxin. Increased cultivation of glyphosate tolerant crops has in turn increased the use of these pesticides. As a result, many weeds have developed glyphosate tolerant strains, thus causing harm to aquatic organisms. On historical grounds alone, Finland would have an excellent opportunity to present an initiative concerning this in the context of the common agricultural policy of the EU.

It is misleading to market manipulation to combine fully different species of organisms, such as bacteria and plants, as breeding. Breeding is evolution consciously steered and speeded up by humans, taking advantage of selection and hybrids of different strains of the same species. Instead, manipulation means physical treatment where the natural process and respect for evolution have been forgotten.

Professor in Agroecology/University of Helsinki:
It is very important that farmers can produce their own farm seed without investing every year in breeder seed. Most part of the historical adaptation of agriculture has been and will be based on this practice. Seed trade between farms should also be allowed.

The origin of genetic material should be certificated in such a way that it is guaranteed that the material has not been exported illegally e.g. from natural resources of a tropical country. Fair trade should be guaranteed for genetic material as well.

Professor in Microbiology/University of Helsinki:
No-tillage farming is one way to prevent erosion, but weeds become a problem.
GM crops that resist herbicide would then be favoured. However, the negative effects of herbicide use in cold climates have not been properly studied.

MTT Agrifood Research Finland:

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