GREENPEACE

UNPREDICTABLE; IRREVERSABLE; UNNATURAL

The story of Genetically Engineered Foods

Greenpeace India
#3360, 13th B Main, HAL 2nd Stage
Indira Nagar, Bangalore 560038. India.
www.greenpeaceindia.org

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Genetic engineering (GE) refers to a set of technologies that are being used to change the genetic makeup of cells of plants and animals to bring about a desired commercial function e.g. insect resistant plants, herbicide tolerant plants, increased protein content in vegetables etc. For the first time humans have decided to alter the natural evolutionary process and create new plants and animals through techniques that involve highly complicated manipulations of genetic material and other biologically important chemicals.

UNPREDICTABLE
Genetic engineering can have unpredictable effects because the process is imprecise and random. Inserted genes may disrupt natural genes, be unstable in their new environment, or function differently than expected. There are two ways in which genetic engineering may affect food safety: Gene disruption or instability may lead to new toxins being produced; and the new protein produced by the foreign gene may cause allergies or toxicity.

IRREVERSABLE
Releasing GE organisms into the environment poses special threats to the environment and the food chain. GE crops are living and have the ability to reproduce and multiply. Through crosspollination, the foreign genes they contain can be transferred to other crops and wild species. Genetic contamination can, therefore, magnify over time. GE seeds can also be spilt, mixed with non-GE seed and grown illegally, compounding the problems.

UNNATURAL
Cow genes in Wheat[1] and Spider genes in potato[2] are just some examples of genetically engineered organisms that are being created by scientists in laboratories. Transferring genes across the species barrier doesn't occur in nature. Through genetic engineering scientists have embarked on a journey to alter the evolutionary process. The impacts of this are unknown.

This document takes you through some of the incidents that have been described as accidents and the impact to our food and health in the dangerous world where food is genetically engineered.

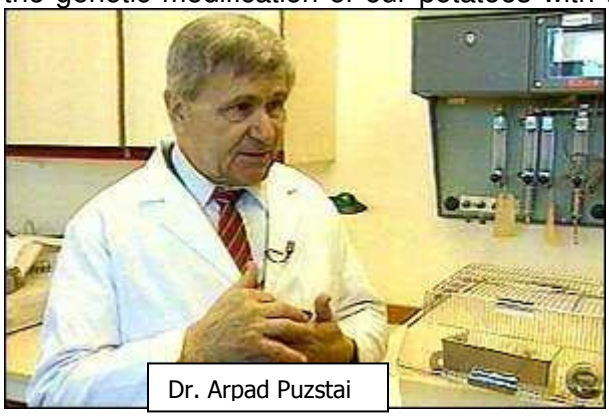
Critical health impacts caused by GMOs

There have been several cases of GM crop disasters in the past. This section takes us through the few cases that have battled corporate efforts to suppress facts and survived the day to reach the concerned citizen. In some of these cases, scientists owned up to the monumental disaster and eventually were ostracized by the proponents of the Genetic Engineering technology. In other cases, data was deliberately suppressed and the risks of the technology had to be forced open by environmental groups

[1] Scientists at the University of Nebraska (Lincoln, USA) have used cow genes in wheat to give wheat fungal (fusarium resistance).
[2] Ref: Scheller J, Henggeler D, Viviani A, Conrad U. 2004. Purification of spider silk-elastin from transgenic plants and application for human chondrocyte proliferation, Transgenic Research 13: 51-57.

Rats that suffered after feeding on GE potato

In 1995 Dr. Arpad Puzstai started a publicly funded major scientific investigation (by the then Scottish Office Agriculture, Environment and Fisheries Department, SOAEFD) into the possible environmental and health hazards of GM potatoes. British GE scientists were using a gene taken from snowdrop bulbs had transformed the potatoes. The gene of this sugar-recognizing protein (GNA) has been known to give natural protection against insect pests. It had also shown in extensive and appropriate nutritional studies carried out by our research group at the Rowett Research Institute in Aberdeen before the genetic modification of our potatoes with the GNA gene that animals ingesting this protein as part of their diet even at an 800-fold excess of that present in GM potatoes, suffered no significant harmful consequences. Therefore it was expected for it to be safe for animal and, later after appropriate testing, possibly for human consumers.[3]


Dr. Arpad Puzstai

Unfortunately, the studies revealed that the two lines of field-grown GM potatoes, which originated from the same transformation and were both resistant to aphid pests were not substantially equivalent in composition to parent line potatoes, nor to each other. Even more importantly, we showed from the results of four rat feeding studies of different designs and durations (10 to 110 days) that diets containing GM potatoes in comparison with iso-proteinic and iso-energetic non-GM parent potato diets had in some instances interfered with the growth of young rapidly growing rats, the normal development of some of their vital organs, induced changes gut structure and function and reduced their immune responsiveness to injurious antigens.
In contrast, the animals fed on diets containing the parent, non-GM-potatoes or these potatoes supplemented with the gene product had no such effects.[4]

The controversy began in August 1998 when Dr Arpad Pusztai, 68, made a public statement about his fears, about the £1.6m study he conducted at the Rowett Research Institute (RRI).

Though the establishment ganged up against him, Dr. Pusztai's findings have never been disproved. This work has in fact clearly demonstrated that, in addition to possible toxicological studies, the safety of GM – food must be established in both short-term and long-term feeding, metabolic and immune-response studies with young animals as these should be the most appropriate to respond to and show up any nutritional and metabolic stresses affecting the normal development of young animals into healthy adults.

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[3] Source: Dr Arpad Pusztai; Submission of Health Impacts of GM Crops: Evidence to the Clerk to the Health and Community Care Committee of The Scottish Parliament)

[4] A Pusztai et al. (1999) Expression of the insecticidal bean alpha-amylase inhibitor transgene has minimal detrimental effect on the nutritional value of peas fed to rats at 30% of the diet. The Journal of Nutrition, 129, 1597-1603.
SWB Ewen an A Pusztai (1999) Effects of diets containing genetically modified potatoes
expressing Galanthus nivalis lectin on rat small intestine. The Lancet, 354, 1353-1354.
A Pusztai (2002) Can science give us the tools for recognizing possible health risks of GM food? Nutrition and Health (2002) 16, 73-84
7. A Pusztai (2002) GM food safety: Scientific and institutional issues. Science as Culture, 11, 70-92.

Within 48 hours after his public statement he was suspended in disgrace and later forced to retire. The RRI said he had misinterpreted his results.

When Dr. Pusztai initially voiced his concerns about the health implications of genetically modified foods on ITV's *World In Action* on August 12th 1998, the biotech company, Monsanto, was quick to react in the press on 13th August 1998, asserting in The Times that "...these revelations are absolute dynamite", adding that "We have...food scares and doom-laden utterances without anyone looking at the facts."[5] The lobby group, Foodfuture, added that the scandal was due to "sloppy science and over-blown reporting...[6]"

Some opinions of other independent scientists on Dr. Puzstai's study:

A group of scientists, drawn from 13 different countries, had re-examined his work and signed a joint memorandum[7] saying his conclusions were justified (1999). The group included toxicologists, genetic engineers and medical experts. "We found that his data is sound", said their spokesman, Dr Vyvyan Howard, a toxipathologist at Liverpool University,

Dr. Putzai's revelations have been backed by an independent analysis by consultant pathologist Dr Stanley Ewen, of Aberdeen University, who examined the preserved rats' organs. But a leading expert said: 'These were measurable changes in the rats fed modified potato - and we feel there's been a cover-up. There should be more openness in the whole business about public money and how it being used in this field.'[8]

Mice that suffered from inflammation of the lungs after feeding on GE peas[9]

After a decade of research, a field trial of genetically engineered (GE) peas was stopped in Australia because a study[10] found serious health impacts in mice that were given the GE peas to eat. The GE peas contained a gene from a bean to make the peas resistant to damage by the pea weevil.

The gene inserted into the GE peas was designed to produce an alpha-amylase inhibitor, a protein that prevents the digestion enzymes of insects from working. This causes the plant to be toxic to them when eaten.

Small changes in protein structure can cause big changes in allergenicity.

Although the chemistry of the protein produced in the GE pea was almost exactly the same as that produced naturally in the bean, the structure of the protein was

[5] The Scotsman, 13th August 1998.
[6] The Guardian, 13th August 1998.
[7] Fears erupt over Genetic food, 12th February 1999, BBC.
[8] The UK Mail, dated 31 Jan 1999.

[9] CSIRO Plant Industry; 2005; Effective risk assessment of GM field peas
[10] Vanessa E. Prescott, Peter M. Campbell, Andrew Moore, Joerg Mattes, Marc E. Rothenberg, Paul S. Foster, T. J. V. Higgins, and Simon P. Hogan JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY Volume 53, Issue 23 (November 16, 2005) pages 9023 - 9030

unexpectedly changed in the GE plant. Small changes in the 3D protein structure can affect their potential to cause allergies. In this case, the researchers found that the GE peas caused allergenic reactions in mice.

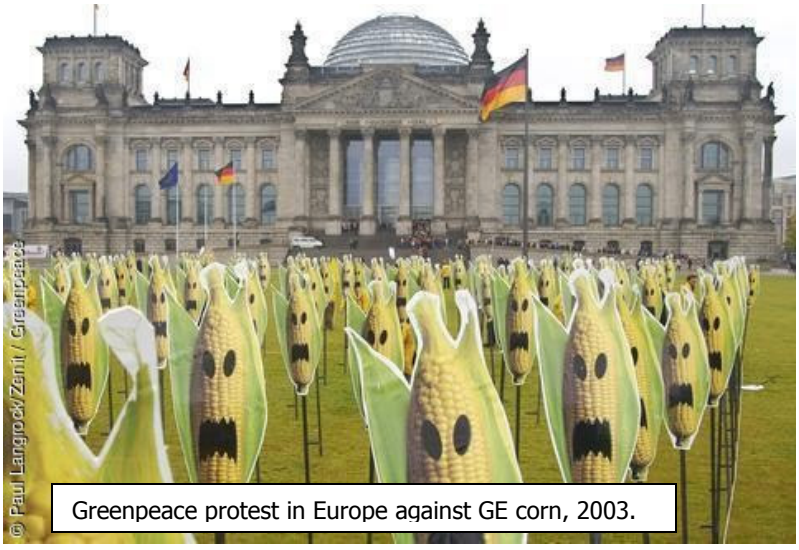
The CSIRO-developed GM field peas (right)

When they inhaled the GE pea protein it caused inflammation of the lungs and when they ate the GE peas they became more sensitive to other food allergies. These effects were not observed with beans that naturally produce this protein.

In the case of this study, the toxic effects were seen within the four weeks of the experiment. Had the toxic effects developed over a long-term period, they may not have been detected by the study. This demonstrates why it is so important that GE crops are properly tested and are not released into the environment.

Rats that suffered after being fed GE corn

On 23 April 2004, *Le Monde* reported that the French expert body in charge of GMO evaluation (CGB, Commission du Génie Biomoléculaire) had expressed doubts about the safety of GM maize MON863. Results of a rat feeding study that Monsanto delivered to EU authorities showed significant variations between rats fed conventional maize and those fed with MON863. The variations included an increased number of white blood cells in the males, reduced immature red blood cells in females, a significant increase in blood sugar in the females and a higher frequency of physical irregularities in the kidneys of the males, such as reduced weight and inflammation.



Greenpeace protest in Europe against GE corn, 2003.

Monsanto requested that documents concerning the risk assessment, like rat feeding trial results, should be classified as "confidential business information".

According to European law, the public has a right to full access to information concerning the risk assessment of GMOs. In particular Article 25 of Directive 2001/18/EC indicates that "in no case" should the information related to "environmental risk assessment" (defined as "the evaluation of risks to human health and the environment, whether direct or indirect") be kept confidential.

The Directive also indicates that the risk assessment should "be carried out in a scientifically sound and transparent manner based on available scientific and technical data".

Greenpeace had been pursuing this since April 2004, and it took us more than a year to see the interests of society at large would prevail to have access to “confidential business information” over Monsanto's economic interests and its policy of opacity and secrecy.

The chronology of the campaign is as follows:

· On 5 May 2004, Greenpeace wrote to the German agriculture ministry, which was in charge of the initial risk assessment report, to request access to the full documents concerning Mon 863.

· On 4 August 2004, the German agriculture ministry replied that the applicant, Monsanto, had refused to agree to publish the initial rat study MSL-18175, which had been classified as "confidential business information". · On 21 March 2005, the German authority decided to give access to the full document, because Monsanto could not show that its request for confidentiality was backed by EU or national law.

· On 27 April 2005, Monsanto filed an appeal against the decision of German government and, in addition, took out an injunction to stop the authorities publishing the data.

· On 9 June 2005, the German court decided to reject Monsanto's request; the data could not be seen as confidential, the right of society to transparency had to be given more weight than Monsanto's economic interests. The company appealed the decision.

· On 20 June 2005, the court rejected the appeal, and ruled that the documents be made public.

GE Corn (Starlink) – a potential allergen to humans enters the food chain

Even if the allergenic potential of a GE crop is recognised by the regulatory authorities, it can still end up in human food. Aventis’ StarLink was a type of insect resistant GE corn grown in the USA from 1998, which produced the *Bt* protein, Cry9C. It was only approved for animal feed and industrial purposes, as there were concerns that the Cry9C protein could cause allergies because it shares characteristics of other allergens.

However, in September 2000, StarLink was found in corn taco shells and other foods, and over 300 corn products had to be withdrawn from the market. Traces of StarLink corn were also found in corn-based foods in Japan and Korea. It is not known how StarLink came to be in the human food chain - it may have been inadvertently mixed with other corn at a mill, a conventional crop may have cross-pollinated with a StarLink crop, or a farmer may have sold StarLink corn for human food to get a higher price.

While StarLink is not being grown anywhere in the world at the moment, it may have contaminated other corn seed and remain in the food chain. The episode raises questions about the ability of regulatory authorities to control GE crops.

Industry observers estimate that the entire cost of the scandal has exceeded US $1 billion. Neil E. Harl, a professor of economics at Iowa State University, estimates that the company has already paid out more than $500 million to farmers, food processors and grain handlers[11]. At least 300 food products in the US had to be recalled, at an undisclosed cost to the food manufacturers. There were also recalls in Canada and Japan. US corn farmers lost huge markets all around the world. US government officials estimated that it might take four years to get StarLink out of the US food and seed supply. Now, three years after the scandal, approximately 1% of samples sent to USDA testing labs are still found to contain StarLink[12].

Some of the costs of the contamination scandal can be detailed:

- Aventis paid at least $100 million to buy back the 2000 crop.[13]
- The United States Department of Agriculture spent $20 million to buy seeds from small companies whose seed stock was contaminated.[14]
- Kraft lost an estimated $10 million in lost sales from its taco shells alone.[15] Taco Bell franchises were awarded $60 million by all the taco shell manufacturers: Kraft, Azteca Foods and Mission Foods.[16]
- Aventis, Garst and four food companies (Kraft, Kellogg, Azteca Foods and Mission Foods) settled a class action consumer lawsuit for $9 million to customers who said they suffered allergic reactions[17].
- Aventis and Garst settled a class action lawsuit by farmers seeking compensation for lost markets. The lawsuit sought damages as well as a requirement for Aventis to decontaminate all soil, farming equipment, etc. to prevent further contamination. The firms will pay $110 million; farmers are likely to receive only US$1 per acre.[18]

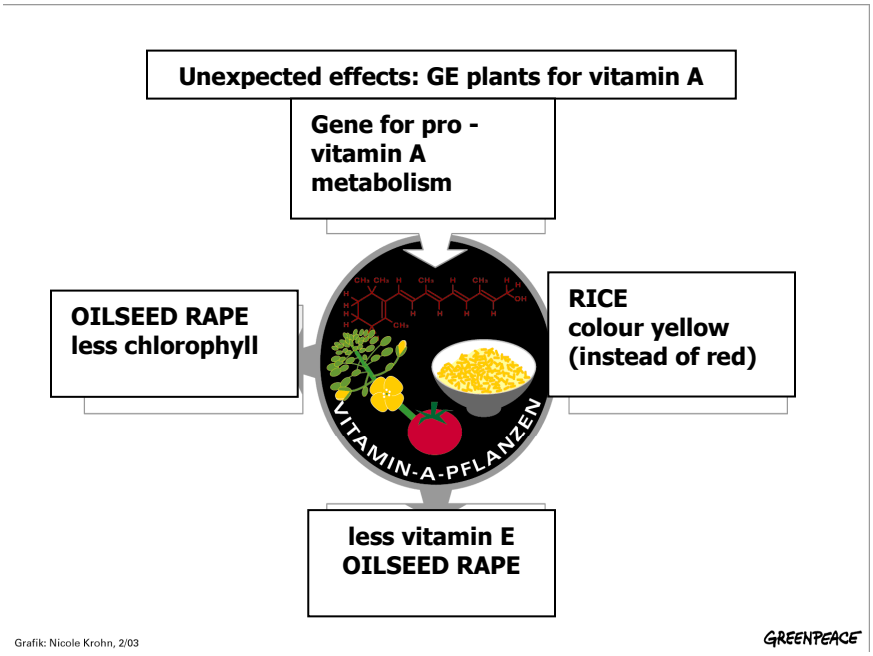
Unintended effects of Genetically Modified Organisms (GMOs):

There are numerous cases of documented unexplainable effects of GMOs. Here are a few examples:

- Researchers at Monsanto who were trying to increase the content of carotenoids (a chemical which is used to form vitamin A) in oilseed rape (canola) found that vitamin E and chlorophyll levels in the seeds were dramatically and inexplicably reduced[19].

[11] Jacobs, P. 2003. Traces of contaminated grain still showing up in corn supply. 30 November. San Jose Mercury News.
[12] Ibid
[13] Reuters. 2000. Aventis sale of bio-crop unit could hurt farmers. 27 November
[14] Schuff, S. 2001. Major seed companies say they have StarLink isolated. 12 March. Feedstuffs.
[15] Madigan, K. 2003. Risky business. Los Angeles, CA: State Public Interest Research Groups, As You Sow Foundation
[16] Cohen, D. 2001. Taco Bell franchisees to get $60 million. 8 June. Reuters.
[17] Carroll, J. 2002. Judge will approve a settlement on use of StarLink corn products. 7 March. Wall Street Journal (New York)
[18] No author. 2003. Aventis settles StarLink lawsuit. 12 February. Chemical Week.

[19] Shewmaker, C.K., Sheehy, J.A., Daley, M., Colburn, S. & Yang Ke, D. (1999) Seed-specific over expression of phytoene synthase: increase in cartenoids and other metabolic effects. The Plant Journal, 20, 401-412.

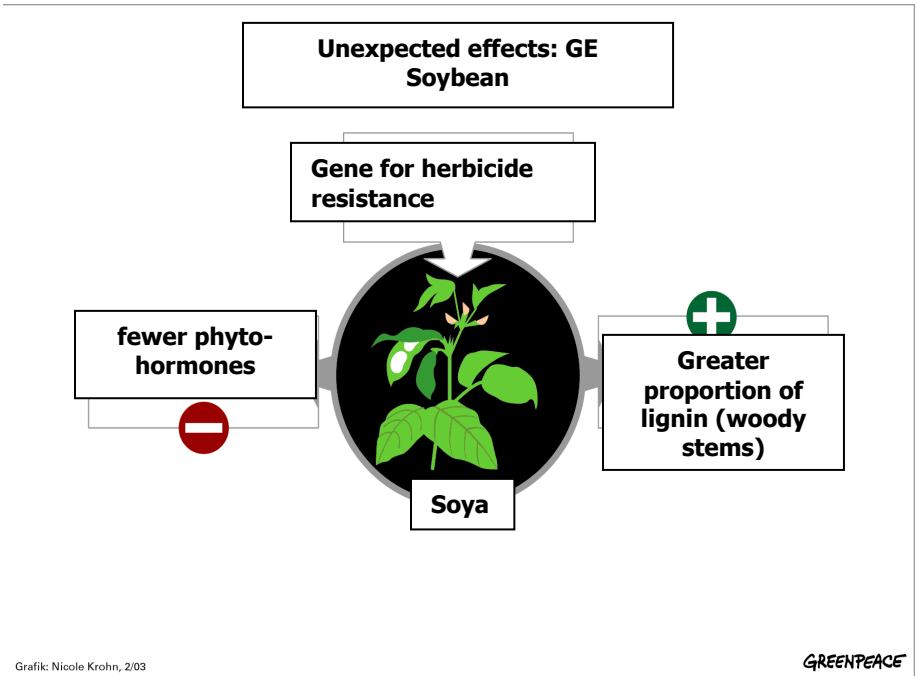


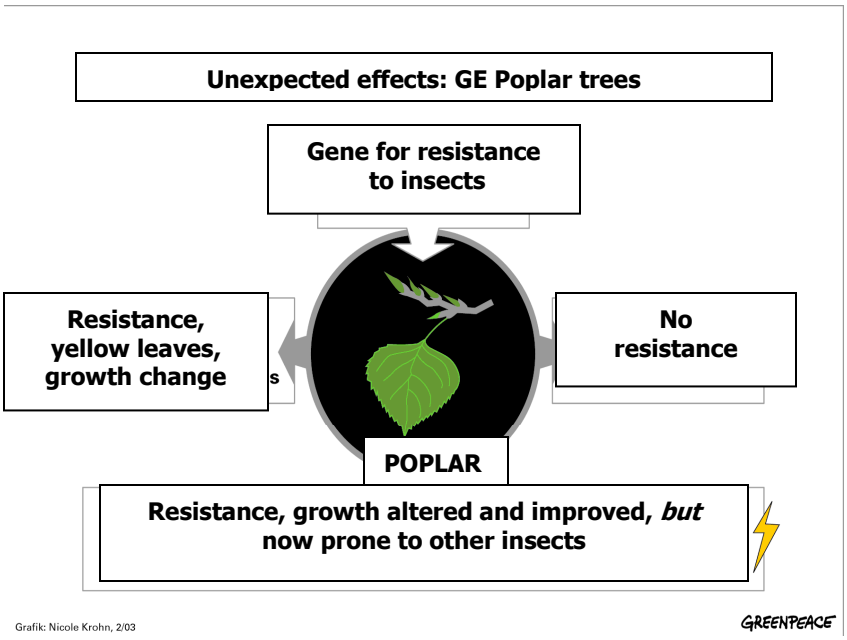
- The colour of the infamous "Golden" rice is an unexpected effect of GE. The GE construct originally contained three genes. The first two genes produce lycopene (red pigment in tomatoes) while the final gene transforms the lycopene to beta-carotene (yellow pro-vitamin A).

  Rice kernels from plants with only the first two genes were expected to turn out red because of the lycopene, but they were yellow. The reason behind the colour of rice turning out yellow and not red with just the first two genes is not understood. Scientists involved in the study have been unable to explain how the rice turns yellow with only two genes.[20]

- Monsanto's GE Roundup Ready soybeans have suffered unexpected crop losses in hot, dry weather due to stem splitting caused, most probably, by increased lignin[21]. The soybeans' phytoestrogen levels are also 12-14 % less than in conventional soybeans, which may mean that soy-based products derived from Roundup Ready soybeans would be less useful as sources of phytoestrogens.

[20] Beyer P. et al. 2002, Golden rice: introducing the B-carotene biosynthesis pathway into rice endosperm by genetic engineering to defeat vitamin A deficiency. American Society for Nutritional Sciences, 132: 506S-510S.
[21] Coghlan, A. (1999) Splitting headache – Monsanto's modified soybeans are cracking up in the heat. New Scientist, 20th November, p.25.





- Disconcerting effects have been observed with poplar trees: a field test which was started in 1996 produced female blossoms on a plant after only three years, whereas normally poplars start blossoming only at the age of eight years. This early

blossoming could increase the rate of unintended spread of the GE trait into the population.[22]

- In China, poplar trees were engineered for insect resistance. The trees did express the desired effects towards the pest insects in field trials. However, just two years later, new and unexpected sensitivities towards other insects occurred.[23]

How 'risk assessment' fails to measure human health impacts

Risk assessment is often portrayed as a relatively straightforward process – simply identify all possible hazards, calculate the probability that they may arise, work out what the risk is, decide if it is acceptable and how to manage it. It sounds very scientific and impartial, but it is not. This protocol was initially conceived to deal with failures in machinery, when it is applied to GMOs it struggles with the complexity of the natural environment. Because it is this system that underlies the regulation of GMOs worldwide, protection of the environment and human health is being compromised.

The **'Precautionary Principle'** builds on a series of straightforward and well-established ideas that[24]

- Prevention is better than cure;
- The polluter should pay.
- We should look for 'no regrets' options.
- We should recognise the intrinsic value of non-human – as well as human – life.
- The complexity and variability of the real world limits the ability of scientific knowledge to predict.
- We must recognise the vulnerability of the natural environment.
- The rights of those who stand to be affected by an activity must be prioritized rather than those who stand to benefit from it.
- There must be scrutiny of all available alternatives and an examination of justifications and benefits as well as risks and costs.
- Long-term, holistic and inclusive perspectives are needed in environmental protection.
- Policy analysts have concluded that the Precautionary Principle is more scientific than conventional risk assessment.[25]

Therefore, a precautionary approach introduces a more scientifically rigorous analysis, with a broader scope and wider range of experts. Precaution is involved at all steps in decision making, in areas where action may lead to seriously harmful effects, from the practice of science and the research agenda, to regulation and governance. Because the threats of GE are so broad, and it's harmful impacts could be severe and irreversible, the precautionary principle must be strictly applied.

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[22] Fladung, M.; Nowitzki, O., Ebbinghaus, D., Schellhorn, A.; Bentien, G., Ahuja, M.R. & MuhS, H.J. 1999, Field release of ROLC-transgenic Aspen-Populus. Online: http://users.ox.ac.uk/~dops0022/conference/forest_biotech99_home.html, Poster 46, 3.12.1999.

[23] Ewald, D. & Han, Y. 1999, Freisetzungsversuche mit transgenen Pappeln in China. UBA-Fachgespräch „Freisetzung transgener Gehölze – Stand, Probleme, Perspektiven" 20. & 21. Sept., Humboldt-Universität zu Berlin.

[24] Stirling, A (1999) Science and precaution in the management of technological risk. Report for the European Commission – JRC Institute of Prospective Technological Studies, Seville. http://www.jrc.es/pub/EURdoc/eur19056Ien.pdf

[25] European Commission (2000), Communication on the Precautionary Principle, COM (2000)1, Brussels: European Commission