Committee: Environment Sub-commission 2

Issue: Measures to prevent genetic pollution

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INTRODUCTION

It is true that in the past genetics were not even considered as source of pollution. This changed when genetically modified organisms (GMOs) were introduced by genetic engineers. A strain of antibiotic resistant tobacco plants was introduced in 1983, and these became the first organisms to be considered GMOs. Since then, genetic engineers have been altering life itself, producing organisms that were not possible to occur naturally and hence are not a product of the natural environment. This development has considerably helped humans in their lives as it is giving them the opportunity to isolate harmful genes or even keep/reinforce the most desirable traits of certain organisms.

Genetic engineering is considered by Greenpeace, TRAFFIC, Gene Watch UK, and some conservationists as a threat to human and environmental health, introducing the concept of Genetic Pollution. In the modern world there is an uncontrolled spread of genetically modified organisms even in the food that we consume, making those modified genes present even in the human body.

The main concern of environmental and healthcare organizations is that these new and “unnatural” organisms may somehow hybridize with unmodified and natural one and produce new organisms that carry undesired features and invade natural habitats. This remains scientifically unproven. However, altering the natural gene pool by introducing new genes cannot be considered positive by environmental organizations. Many solutions have been proposed regarding the issue by many different organizations and treaties, which have been made in order to make the pollution less threatening to both human life and the environment.

DEFINITION OF KEY TERMS

Genetic Engineering

The development and application of scientific methods, procedures and technologies that permit direct manipulation of genetic material in order to alter the hereditary traits of a cell, organism or population.

Genetic pollution

The uncontrolled spread of genes of genetically modified organisms to wild populations. It is used mostly by those who consider it undesirable.

Cross-pollination

The transfer of pollen from one plant to another of different genetic constitution.

Indigenous species

An organism that occurred in a region only by natural processes.

Feral species

Wild animals that descended from domesticated ones.

Introduced species

A species that is not indigenous and was brought to a specific area or ecosystem by humans. It is considered damaging to the environment of a certain region because it did not occur naturally and is spreading to a large degree.

Domestication

To tame animals especially by generations of breeding, to live in close association with human beings as a pet or work animal and usually creating a dependency so that the animal loses its ability to live in the wild.

Gene pool

A collection of all the genetic variants amongst biological species in a selected environment.

BACKGROUND INFORMATION

DNA history

To understand the concept of genetic engineering and pollution better, it is necessary to have some background knowledge on the discovery of the DNA structure. The first one to talk about some heritable material was an Austrian monk, named Gregor Mendel who cross breaded pea plants and concluded that there is something that passes characteristics from the parent plant to the offspring. In 1962, the Nobel Prize of Medicine was awarded to Crick and Watson who uncovered the DNA structure which remains today as the basic molecule of inheritance. The DNA molecule, as described by these scientists, consists of two complementary chains of nucleotides, made of pentose sugars, one or more phosphate groups and a nitrogenous base.

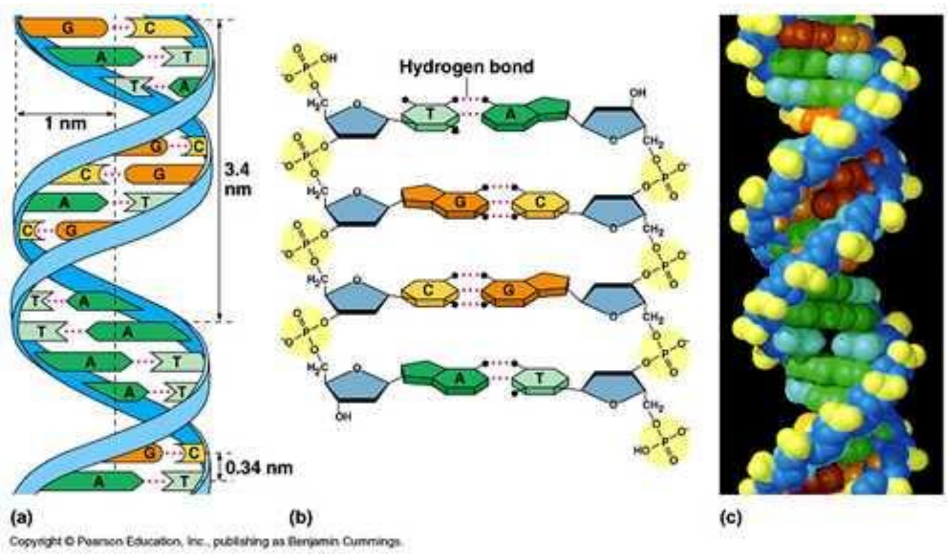


Figure 1: DNA structure

Genetic Engineering

The fact that DNA is "a universal language" helps scientists in their goal to genetically modify organisms in order to make them more resistant and stronger. The process of genetic engineering works by isolating a specific gene within an organism and identifying if this specific gene can be useful for another organism as well. It is in fact the removal of a gene from an organism and the addition of it to another which gives the second organism the opportunity to express the trait that is encoded by the specific gene. For example, when scientists decided that the protein contained in the spider's web is useful they wanted to find a way to produce it in a larger scale. For that reason, they inserted the gene that encodes for the production of this protein in goats resulting in the famous "spider-goat" that has the spider's web protein in her milk. Similarly, genetically modified organisms are the "Enviropigs," the fast-growing salmons, specific types of tomatoes, potatoes, and tobacco. As we can understand, genetic modification of organisms has become a rather big part of a human's life today.

On the other hand, it is important to look at the positive outcomes of genetic engineering to the environment. First of all, the agricultural advantages are significant. Farmers now have the chance to grow crops that are tolerant to pests and various sprays that harm the crops. It should also be mentioned that vaccines, growing insulin and gene therapy would not exist without genetically engineered (GE) organisms. However, more often than not farmers overuse those crops without any weed-control tactics which could possibly result to "immortal crops". So, even if there are advantages, the possible dangers for the environment are great.

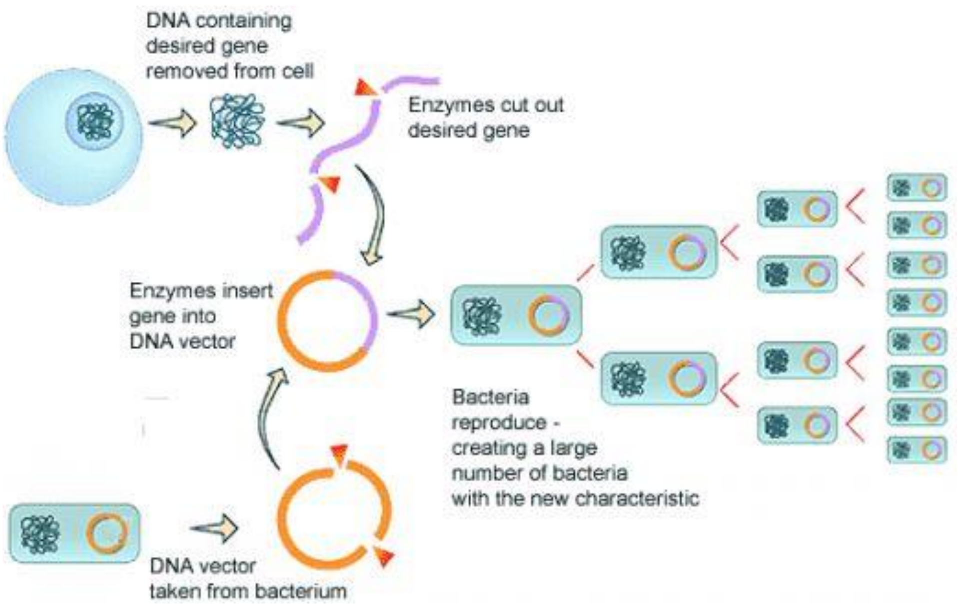
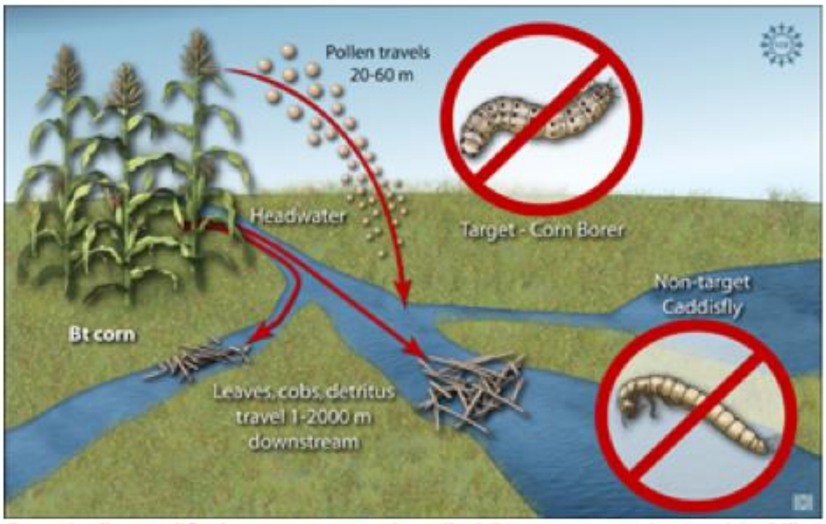


Figure 2: Genetic Engineering

Genetic pollution

We can probably say that genetic pollution originates from natural and artificial causes. However, the natural genetic pollution which occurs over the million years of evolution and natural selection is almost non-existent. The dangerous form is the artificial one that stems from uncontrolled genetic engineering. To be more specific, genetically modified genes are almost impossible to fall under the scope of any control. Once they have been produced, it is just a matter of time for them to spread, altering the indigenous species and having destructive consequences for the biodiversity of whole ecosystems. If we take for example South America, from where many varieties of maize have originated, and add to that environment genetically modified maize, then it is obvious that all other kinds of maize will be gone and replaced by just one: the artificial one. Another example could be the danger of lethally contaminating crops with genes that come from other organisms. It should be noted that all these examples are completely hypothetical and have not been seen yet in the environment. It is also significant that right now there are 26 genetically modified crops for approval in the European Union.

The effects of genetic pollution could be summarized. Firstly, the genetically modified genes could lead certain non-GMOs to extinction and some naturally-occurring genes might undergo permanent mutations leading some traits and characteristics to be lost. To add to that, crops that are tolerant to pesticides can be a real nightmare as they will grow indefinitely with no control. The lack of diversity is extremely dangerous because it has been proven through history that reduced diversity has led to some of the most dangerous crop epidemics. In 1970 the maize in the US was attacked by a disease called Southern corn leaf blight. The fact that there was uniformity in the genes meant that 15% of the harvest was lost.



Genetically modified corn, commonly called Bt corn, is engineered to kill pests such as the European corn borer. However, a new study shows that Bt corn may also harm the caddisfly, which serves as food for fish and amphibians. The new study also shows that parts of Bt corn, such as leaves, cobs and pollen, can travel as far as 2000 meters away from source areas--a phenomenon that was not considered when Bt corn was licensed.

Credit: Zina Deretsky, National Science Foundation

Figure 3: GMOs and their potential harms

MAJOR COUNTRIES AND ORGANIZATIONS INVOLVED

United States of America

According to reports, the USA produces 69% of the genetically modified organisms of the world. It is significant that in 2011 more than 93% of soy beans in the USA were genetically engineered. The US does not have any federal legislation specifically for GMOs, making the flow and spread of GMOs uncontrolled. They assume that regulation should focus on the nature of the products' purposes, rather than the process by which they were produced. In that way they actually favor their development as their economy depends largely on GMOs. The United States is the only country that favors the development of genetically modified organisms in such a large scale, which justifies the large percentage of genetically engineered food in the American market.

Brazil

Brazil is the second largest producer of genetically modified organisms in the world. Characteristically, it produces more than 30% of the total GMO world production. It is true that in 1998, GE organisms were banned from the market by a Lawsuit of the Brazilian Institute of Consumer Defense. Later, in 2003 the market opened again to GMOs following the issue of the Labeling Decree (4680/2003) which required the GMO products to be labelled before sold. In 2005, the Bio-Safety Act (11.105/05) allowed their use without any knowledge of the environmental impact. 88.8% of soy beans are genetically modified in Brazil. It should be noted that according to Brazilian experts, GE is more than necessary for their economy as the conventional methods of agriculture are unable to sustain the country for various reasons.

Greenpeace

Greenpeace is one of the first environmental organizations that condemned the use of genetically modified organisms as well as the development of genetic engineering. To be more specific, Greenpeace believes that GMOs should not be used as there is not enough knowledge on the environmental impact that they could possibly have. They demand that all GE crops should be clearly labelled as GMOs in order to be distinct from regular crops. Also, according to Greenpeace, since herbicide tolerant crops increase the use of herbicides, such crops should not be produced. Believing that life cannot be an industrial commodity they clearly oppose all animals and crops that are made in an unnatural way and not according to the laws of nature.

Figure 4: April 2010: Farmers, environmentalists and consumers from all over Spain demonstrate in Madrid under the slogan "GMO-free agriculture." They demand the Government to follow the example of countries like France, Germany or Austria, in banning GM maize cultivation in Spain

Gene Watch UK

Gene Watch UK is a non-profit organization that monitors biotechnological factors involving human health and environment. This organization (similarly to Greenpeace) is concerned about the uncontrolled spread of GM crops like maize and soy beans that enter Europe in general and Great Britain in particular. For this reason, Gene Watch is working in order to control the authorization process for GMOs and takes a precautionary approach. They are also fighting for liability rules that will compensate farmers if their products are contaminated and asking for payment by the biotechnology industries.

TRAFFIC

The TRAFFIC conservation program aims to regulate and ensure that the food, animals and plants that circulate around the planet will be produced in ways that do not endanger the conservation of nature. It is a joint program by the World Wide Fund for Nature (WWF), the International Union for Conservation of Nature

(IUCN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). They also believe that genetic pollution is one of the most serious forms of pollution the world has to face today, as the biodiversity and conservation of ecosystems are endangered due to the uncontrolled flow of genetically modified genes. The program is an outspoken member in the discussion of GMOs, and it proposes several measure for their mitigation.

UN Food and Agriculture Organization (FAO)

The Food and Agriculture Organization is an official UN organization that has six main bodies. Its goals include making forestry, fisheries and agriculture more productive and sustainable while at the same time reducing food insecurity around the world. It has actually created the Treaty on Plant Genetic Resources on Food and Agriculture and the Commission on Genetic Resources for Food and Agriculture. This organization is working, together with the UN and its organs, towards food security and the maintenance of the global biodiversity of ecosystems. They are trying to regulate the genetically modified organisms and their circulation because of the fear that such organisms are able to disrupt the normal flow of ecosystems and natural environments and result to the loss of biodiversity around the planet.

TIMELINE OF EVENTS

Date	Description of Event
1973	First genetically modified animal, a mouse, is formulated.
1976	The technology of bacteria that produced somatostatin is commercialized.
1978	Bacteria that produced insulin are engineered
1983	First genetically modified antibiotic-resistant tobacco plants are engineered
1992	The antibiotic resistant tobacco is commercialized in China.
1994	The first GMO food is marketed, the Flavr Savr tomato.
1994	The term genetic pollution is first used by Butler D.
2000	The “Science” magazine introduces to the public the golden rice, the

	first GMO with increased nutritional value.
June 2006	The first time that the body of the international treaty on plant genetic resources on food and agriculture meet.
2010	29 different countries have introduced genetically modified crops which are being cultivated in the interest of the country at this time.
17 October 2014	A UN conference decides to double the funds for biodiversity starting in 2015 and for five years in developing countries.
25 November 2015	New UN and FAO guidelines issued in order to help countries manage genetic resources better when coping with climate change.

UN INVOLVEMENT: RELEVANT RESOLUTIONS, TREATIES AND EVENTS

International Treaty on Plant Genetic Resources on Food and Agriculture

The International Treaty on Plant Genetic Resources on Food and Agriculture has created an international genepool to ensure food security with 1.6 million samples of genetic material in order to make research on crops like rice, maize, wheat and others easier.

Resolution FAO/6.1.2

Suggests basically the reduction of the dependence on GMOs on a worldwide scale and the labelling of genetically modified organisms when available for sale at the public.

Commission on Genetic Resources for Food and Agriculture

Alarms the world for the important loss of genetic diversity and tries to combat the issue.

PREVIOUS ATTEMPTS TO SOLVE THE ISSUE

It is necessary to understand that genetic pollution is a quite new form of pollution that has not been officially recognized by all governments and organizations, as is the case, for example, with air or sea pollution. For that reason, there have not been any previous attempts to solve the issue per se, but in fact all measures taken are trying to conserve biodiversity and control the distribution of GMOs. Conservation measures like that are actually eradicating genetic pollution.

To begin with, as far as the UN is concerned, the issue falls under the supervision of the FAO, which has already taken measures for its eradication. According to the FAO, the potential benefits of genetic resources are enormous. However, they are underutilized. The

International Treaty on Plant Genetic Resources for Food and Agriculture is an important attempt to create a global genepool. In that there will be genetic samples from most species and they will be conserved no matter the genetic pollution implications to the environment's biodiversity. Research on important crops is also facilitated together with the easier circulation of seeds, plants and crops around the world. The treaty recognizes the enormous contribution of farmers to the global economy and hence protects their rights. It has established a benefit sharing of crops between countries and is trying to establish food security together with sustainable development.

The commission for genetic resources for food and agriculture is also established by the FAO as a way to preserve the biodiversity of animals and plants, threatened by the modern way of agriculture. The FAO recognizes that GMOs contribute to the food insecurity and also that GMO farmers hold the monopoly against the organic farmers and has voted for an important resolution that is asking for the clear labelling of GMOs and the independence from GMO crops. It also proposes the implementation of taxes and tariffs on countries that import GMOs (Resolution FAO/6.1.2).

POSSIBLE SOLUTIONS

First of all, it should be understood that completely banning GMOs from circulating and being used around the globe for any medical, agricultural or commercial reasons cannot be a solution because the advantages that genetic engineering offers are revolutionary and important to modern society. In addition, the partial dependence of certain national economies on GMO products must not be disregarded, as it would prove financially unviable if such products were to be banned altogether. Nevertheless, it is clear that when looking at the problem of genetic pollution we should have as a priority the health of the people and the preservation of the environment.

One of the solutions should definitely be the clear labelling of the products that come from raw genetically modified organisms as GMOs. In this way it will be clear for everyone what is genetic engineered and what is not and the public will have a choice. Also, if we know clearly which products are genetically modified, a form of control will be implemented and the spread of GMOs will not be completely uncontrolled. People must be provided with the necessary information about the process that GE crops and foods have undergone and the possible health as well as environmental risks of them so that they will be able to make their own decisions on the issue. In that way consumers will be responsible for their choices and at the same time we will be able to say that some products are 100% GMO free, something that is not possible today, according to the International Federation of Organic Agriculture movements.

In general, it would be helpful if such genes were kept out of the supply chain and the natural ecosystem, so that the natural environment will be preserved and that the health of the public will be assured. A biological solution could come from stopping the cross-pollination of plants when their pollen is genetically engineered. This could happen by sterilizing the male parts of the plant so that the pollen production would stop. This technique however would be impractical in plants whose fertilization depends on the pollen transportation from one plant to another.

A second biological approach could be associated with the chloroplasts of the plant. If the genetically modified genes are kept out of the pollen of the plant then the transgenes will not be passed along to other flowers. Those GE genes are added to the nucleus. At the same time, chloroplasts also contain genetic information. Pollen does not contain the genetic information from the chloroplasts, but instead from the nucleus. If the chloroplasts get GE instead, the modified genes will get locked inside the plants and thus their spreading will be prevented.

Another way of controlling genetic pollution would be to control the seeds that get planted by farmers and prevent unwanted seeds from sprouting. One technique that could possibly be implemented would be to ask farmers to rebuy their seeds for the next season rather than planning their harvest from the previous year. In that way, the second generation of GMOs would not be fertilized and grown. However, this would not be in the advantage of farmers due to the costs, something that should also be addressed.

It goes without saying that the genetic banks that are planned to be created by several organizations would be further supported by all member states since this will lead to the maintenance of biodiversity if we have in our hands genetic samples of various organisms that are in the danger of becoming extinct.

Generally, there could possibly be many solutions and proposals that could lead to the eradication of the problem as well as the fear of the possible outcomes of such pollution to the planet and the ecosystems.

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