Life, Lineage and Sustenance

Indigenous Peoples and Genetic Engineering:
Threats to Food, Agriculture, and the Environment

by
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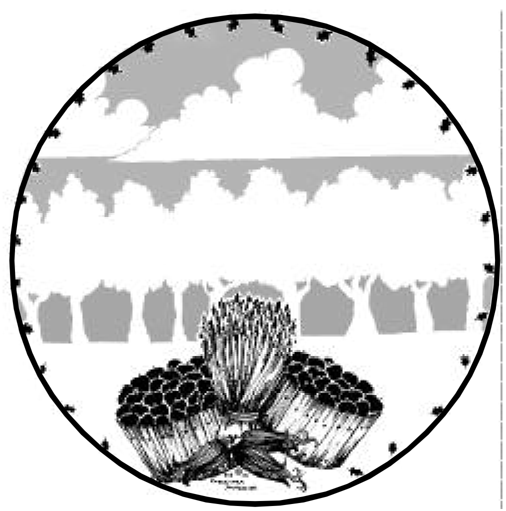

A Primer and Resource Guide

INDIGENOUS PEOPLES COUNCIL ON BIOCOLONIALISM

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INTRODUCTION

Genetics is the study of the structure and function of genes and of the transmission of traits and the genes associated with traits between generations. Awareness of genetic processes has a history that is thousands of years old and probably began when humans first noticed similarities between parents and offspring, or that certain traits or characteristics run in families. Agriculture, and the understanding of plants and animals, is a community science that is firmly rooted in the cultures of people and their spiritual beliefs. A society's agriculture reflects much about its values and its relationship to the earth.

Throughout the centuries, indigenous peoples have developed many varieties of plants and have domesticated animals. Ancient civilizations, including the Chinese, Romans, Egyptians, and many cultures in the Western Hemisphere applied agricultural genetic knowledge to "develop" many different domesticated plants and animals.

For indigenous peoples, agricultural genetic knowledge encompasses a web of relationships among the earth, plants, animals, and humans. This knowledge is tied to the cycles and rhythms of changes in the earth, and is the result of centuries of practice, observation, and continuing innovation. It is a collective community knowledge that is passed down through the generations. This ever-growing traditional understanding of plant and animal life in their territories has allowed peoples to meet their communities' nutritional, medicinal, and spiritual needs. Present-day indigenous peoples are the stewards of different strains of plants developed over generations of cultivation, extensive traditional knowledge, and biologically diverse ecosystems.

The New Genetics

Modern agricultural genetic knowledge is a new way of looking at plants, animals, and humans, and the ways that food, medicine, and other products can be produced. It views life, the complex web and dynamic interactions of living beings in that web, through a microscope. From this perspective life looks very different. At the molecular level, the wider environment, the cycles and rhythms of the earth, and the individual histories of living beings in their different settings are so distant they are almost invisible.

The incredibly fast growth of the "new agricultural genetics" started when it was found that humans could move portions of DNA (genes) between organisms, and so the genetic engineering revolution began. New technologies were quickly developed to allow for the manipulation of DNA to be commercialized. To this end, and for the first time in history, the genetic material of humans, plants, animals, and microbes are being transferred into one another. Genetic engineering techniques are being developed to manipulate the genes or the genetic makeup of living beings to produce commercially valuable products. These technologies are being used in many areas of production, such as the health industry, industrial raw materials, and food.

Accompanying these technologies is a new gold-rush to identify agriculturally interesting genes from plants and animals across the world that can be used in these processes. In particular, the agricultural and medicinal knowledge of indigenous and traditional farming communities are being targeted for their potential commercial value, as are the species of living beings who live in the environment surrounding indigenous peoples. Every living species has suddenly become a reservoir of potentially useful genes, or the possible host for the cultivation of interesting genes or substances that can be later extracted. In this industry, all life is a commodity.

As with all agricultural practices, these new agricultural technologies are the products of their culture. In this case, they are a product of the values and goals of Western societies. Modern agricultural genetics follow in the footsteps of Western industrial agriculture, and share its priorities of: mass production, monoculture, international trade structures, and the subordination of agricultural practice to the requirements of free-trade and urban-consumer societies. And this new agriculture is greedy for land.

The heavyweights of genetic engineering are a handful of transnational corporations, among them **Monsanto** (US), **DuPont** (US), **Aventis** (France/Germany), **Syngenta** (a Novartis/AstraZenecca Crop Sciences merger) and **Empressa La Moderna** (Mexico). Together, these companies control 68% of the global agrochemical market, and over 20% of the commercial seed trade worldwide. Many of them have emerged from the petrochemical revolution, and were among the companies behind the industrialization of agriculture through the production of a wide range of agrochemicals.

Since the 1980s, such companies have been investing in genetic engineering research, often with substantial governmental funding support, and often in collaboration with state and federal agencies and academic institutions such as universities. In the mid-90s, companies such as Monsanto and DuPont concentrated on buying up seed companies throughout the world, to ensure their control of seed diversity, market reach, and competitive positions at the head of the agro-genetic engineering revolution. At the same time, many of the companies increased their focus in the food and health product markets. They have sought to promote themselves as a new and beneficial commercial phenomenon – the so-called **life sciences industry** – a term that clearly indicates their commercial project of making life into a commodity and putting it out into the market place. These transnational corporations have strategically bought up companies (large and small) in a number of countries in order to widen their ownership and directorship of plant diversity, local knowledge and research orientation, and in order to establish a "legitimate" place at the domestic political table. Simultaneously, their transnational status is a means to establishing their place at international negotiating tables, where worldwide genetic engineering regulations must be developed.

There is also a fast increasing number of small companies, often the commercial extensions of academic researchers, that work in collaboration with so-called **gene giants.** These small companies

The Big Sell

What the companies and supporting government and scientific bodies are saying about genetic engineering...

- *Genetic engineering technologies are necessary to feed the world*
- *Genetic engineering will benefit all farmers and all communities everywhere*
- *Genetically engineered seed is better than traditionally bred seed lines*
- *Genetic engineering technologies are ecologically sustainable*
- *Genetic engineering will improve nutrition*
- *Genetic engineering is safe*
- *Rejection of genetic engineering is backward and denies future generations hope for great benefits*

are considered to provide a great deal of the innovative force behind the genetic engineering (GE) revolution, whereas the GE giants have the political and economic force to bring these innovations to mass markets.

Increasingly, the industry's strength lies in the willingness of **state-funded scientific and academic research and training institutions** to supply the know-how, staff, and facilities for developmental research. Government and intergovernmental financial support (through facilities such as the United Nations, the European Commission, and the World Bank) also contribute significantly to the political and economic base and stability of the industry.

Industrialized governments are providing the genetic engineering industry with millions of dollars to introduce these technologies to so-called developing countries. Hundreds of thousands of genetically engineered organisms have been released into the environment for field trials. Commercial cultivation is growing rapidly, due largely to the global reach of the large multinational companies, which have been able to introduce their products almost simultaneously around the world. In 1999, 100 million acres of genetically engineered crops were cultivated commercially worldwide - a 44% increase from 1998. **Over 50% of the US soybean crop and 62% of the Canadian canola harvest in 1999 were genetically engineered.**

The genetic engineers are making big promises of an agricultural revolution that will benefit the whole world, and each and every people. We are told that they are taking over from Mother Nature, and perfecting her work. We are promised that genetic engineering will feed the hungry, and improve the nutrition of wealthier societies. We are also told that it is the only hope to sustain future generations. We are told that traditional farming cannot meet the nutritional, health or economic needs of our communities. We are told that traditional knowledge is out-of-date, and that scientists and the genetic engineering companies are better at evaluating the needs of our communities. We are told that we must modernize if we are sincerely committed to the well-being of our people and the world.

Questions to Ask

As indigenous peoples, we need to be very careful about our communities' response to the new agricultural technologies and the place (if any) that they will be given. We need to have an understanding of how genetic engineering works, and what kind of changes it will create between ourselves and our environments. We need to be able to understand and evaluate the impact of genetic engineering technologies on our territories, and on the life that inhabits these territories. We need to think about how adopting genetically engineered farming will affect the survival of our traditional knowledge systems and the plant and animal life at their base. We also need to understand how agricultural genetics will affect our farming economies, and how it will affect ourcommunities' overall health. The following questions are helpful to keep in mind when considering the science:

- Do I understand and am I comfortable with the processes of genetic engineering?
- Do genetic engineering processes violate or go against my religion, my culture, or my personal code of ethics?

- What use will be made of our tribal knowledge, or of biological samples removed from our territory?
- What effects will the genetic engineering of agricultural plants and animals have on the rest of creation – both that in our territories and on migratory species that cross our territories?
- How does genetic engineering impact upon our community's control and guardianship of the resources and life in our territories?
- What impact will genetically engineered species have on the plants and animals that our communities use for food and medicinal purposes?
- Who will really benefit from genetic engineering in agriculture?
- Will genetically engineered agriculture contribute to the social, spiritual, and physical well-being of our communities now and in future generations?
- What are the community and environmental costs of genetic engineering and who will bear them?
- What effects will genetic engineering have on the socio-economic health of our communities?
- How might the consumption of genetically engineered plants and animals affect our physical health?
- What knowledge and community-based food security practices would better benefit from the financial and political support that is currently given genetic engineering projects?

Genetic engineering in agriculture raises many concerns about what scientists and genetic engineering companies are doing to plants, animals, and people. There are also concerns about the impacts that the new technologies will have on indigenous communities, their knowledge, and their territories. There are also many concerns about how genetic engineering will disrupt or disturb the variety of natural species within the environment.

We are at the beginning of what has been called the genetic engineering revolution, and we are faced with the prospect of a world very different from the one we know. As indigenous peoples, we have choices about whether we wish to participate in this revolution or whether we will try and work against some or all of it. If we choose not to participate, we have choices about how we will protect our people, our traditions, and our territories from these new technologies. We do not have a choice about whether to ignore it, however, just like we do not have a choice to ignore the weather. Very big changes are going on around us, and these changes will impact us even if we try to ignore them. Before we make these choices, we must all understand what is going on and what our choices may entail.

This briefing is intended to assist you by providing an introduction to genetic engineering in agriculture. It outlines the concerns of farmers, ecologists, critical scientists, health and consumer groups, and indigenous peoples around the world. It indicates some of the scientific and practical working evidence that opposition has raised against the claims that genetic engineering technologies are "safe" and even "necessary". We hope that it will give you the information you need to make your own decisions and to raise the issues in your communities.

Agricultural Genetics: Concerns at a Glance

- *Indigenous knowledge and diverse living beings under indigenous protection are being pirated by genetic engineering companies or their agents. These companies are claiming invention of, and legal ownership over, these living beings or their parts—all for commercial purposes.*
- *The original varieties and natural species of life forms in indigenous territories can be irreversibly changed by the deliberate or accidental entrance of genetically engineered organisms*
- *Indigenous agricultural seed and livestock can be harmed by contamination from genetically engineered organisms. Seed and animal lineage may be disrupted, livestock health may suffer and premium markets for non-genetically engineered produce lost.*
- *Community health is needlessly put at risk by the foods whose impacts we do not understand. Risks associated with the consumption of genetically engineered foods include exposure to new undetected toxins, increased exposure to pesticide and herbicide residues, the development of human resistance to important medicinal antibiotics, and higher risks for allergy sufferers and people with special dietary needs.*

Life, Lineage, and Sustenance

Each living being carries within it a heritage it received from its parents, and they from their parents, and so on. The generations are connected by each parent passing along part of its inheritance to the next generation. This heritage is much more than merely the biological inheritance one receives from one's parents.

Part of the heritage each living being inherits includes a place in the world in which it lives. Each being plays a role in its surrounding world or ecosystem. The role it plays, and its ability to play that role, is at least partially influenced by the heritage it has received. This includes not only its instructions for life, but also its relation to the other inhabitants of the surrounding world. Things it does as part of its nature may be critical for its own survival. This interrelation is part of the heritage that living beings inherit from their parents and pass along to their future generations—sometimes in the form of instincts, sometimes in knowledge shared with others.

Human beings have traditionally not only depended on other living beings for their survival, but have also learned from other living beings about how to live. This knowledge may be learned from observation, by innovation, or from cultural and spiritual knowledge. Traits of other beings are frequently found to be beneficial to human individuals and communities, for things like food, medicine, and ceremonies.

Some societies, even many thousands of years ago, cultivated plants and bred animals to meet their own needs. They developed techniques to increase the beneficial qualities of certain plants, and to introduce new qualities by crossbreeding varieties of the same species in order to get, for example, larger grains, taller plants, or sweeter berries. In this way, by taking advantage of the process of living beings inheriting traits from their parents, early societies took advantage of genetics. This was a radically different approach from the type of genetics that has now sprung from the modern western worldview, however.

Compared to the view that all things are interrelated and co-dependent, modern western science provides us with a sharply different way of seeing and understanding the identity and makeup of living beings. Biology tells us about the processes and forces that give and shape life from a different perspective and with different language. Different schools of thought in biology place varying emphasis on the roles of environment, life experience, and genetic programming, in the development of species and their lineage. But there are some generally accepted stories about reproduction, and what living beings are made of. This general western view serves as the basis for genetic engineering.

Primer: The Structure of Cells and Genes

*According to classical biology, the **cell** is the smallest living unit. All living beings – whether bacteria, amoebae, insects, plants, or animals— are made up of cells. Some living beings are only a single cell. Human beings, on the other hand, are made up of about 3 trillion cells. These cells work together to perform many functions – such as storing fat, building bones, growing hair or defending against harmful bacteria. Although they do different things in the living being, most cells have the same components and the same structure. The cells of plants and animals usually have:*

- *A wall, called a **membrane**, that encloses the whole cell*
- ***Organelles**, that function like organs in the body of an animal*
- *A **nucleus**, that contains important* information *needed by the cell or whole organism to function, grow and reproduce.*

*The information that is in the nucleus is also referred to as **genes**.*

Genes are described as basic units that hold certain information about a cell, and about the living being. Put simply, the information that genes hold is instructions for building proteins of the body. To understand this function, it is necessary to understand something about the composition of genes.

*Genes are made up of molecules called **deoxyribonucleic acid** or **DNA** and occupy specific sites on the chromosomes called **loci**. DNA is shaped like two very long twisted threads. It is packaged in a very efficient way: it is coiled tightly in what is said to be a **double helix -** a twisting double-stranded form. These very tight coils, together with proteins, form x-shaped units called **chromosomes**. Chromosomes come in pairs. Not all species have the same number of chromosomes. But for each species, the total number of chromosomes is constant. Fruitflies have 8 chromosomes. Each human cell contains 46 chromosomes (23 are inherited from the mother and 23 from the father). The total 46 form 22 pairs of autosomes, and 1 pair of sex chromosomes. Males have an X and a Y sex chromosome, while females have two X sex chromosomes. The total genetic material of a living being is known as a **genome**.*

Chemically, DNA is composed of the chemical elements carbon, hydrogen, oxygen, nitrogen, and phosphorus. In the twisted ladder shape, or the "double helix," the outer supports of the ladder are composed of deoxyribose sugar alternating with phosphorus. The connections between the supports are like rungs on the ladder and contain two types of paired bases. One paired base is adenine and thymine (A and T); the other is guanine and cytosine (G and C). A gene might be visualized as a certain length of the ladder (which may be large or small) and may contain hundreds of paired bases which may be present in any order, but which are always either A and T or G and C.

At the molecular level, the DNA bases are read three at a time to specify amino acids, which are the building blocks of proteins. Proteins in the body serve structural functions (such as hair or nail cells) or are enzymes which are necessary for the chemical workings of the cells. DNA thus affects the visible manifestations of gene function (otherwise known as the "phenotype") by providing instructions for making proteins in the body—somewhat like a cookbook for the different proteins in the body. Different phenotypes therefore, can reflect different genetic instructions for building proteins—that is, different phenotypes can reflect genetic variation.

One criticism with modern genetics is that the science tends to be reductionist, meaning that it assumes that everything can be explained in terms of genes. In fact many other factors contribute to who or what a being is—such as nutrition, interaction with other species, and other factors in the environment. Reductionism is a tendency of western science, and it is frequently at odds with the indigenous way of thinking about things in the big picture.

WHAT IS GENETIC ENGINEERING?

Over the last two decades, the new way of looking at life and understanding its processes has given birth to new techniques and new industries for the commercial reproduction of life. In agriculture, the genetic engineering industry is using approaches that depart radically from traditional agricultural breeding practices to breed new plant and animal species. Plant and animal breeds were diversified with selective breeding by crossing different varieties from the same or very closely related species to achieve desired characteristics such as taller plants or sweeter fruits. While these traditions continue in small-scale and in 'conventional' industrial agricultural breeding, the new genetic technologies are using techniques such as **transgenics** and **cloning** to experiment with and commercialize life processes.

Transgenics involves the deliberate breaking down of nature's borders, by crossing species that would normally not interbreed. Transgenics works on the assumption that certain genes perform certain tasks that can be successfully transferred into other life forms, where they will continue to perform the same function. Genetic engineers identify genes that they *believe* perform a particular function and then introduce them into the agricultural plant or animal in the hope that these genes will continue to work in the same way in this totally new living being. Transgenics also works on the assumption that the use of laboratory techniques to force the union of species that would not normally interbreed in nature does not violate the natural order. Indeed, supporters of transgenics state that the boundaries between species exist because Nature was not able to move beyond them, and that in their work they are heroically going where Nature was unable to go.

Examples of transgenic crop and animal experiments that have been attempted include introducing fish genes into tomatoes, petunia flower genes into soybeans, bacteria genes into corn, cow growth hormone genes into chickens, and human genes into tobacco, kiwifruit, mice, and sheep. Some of these products are already commercialized.

Cloning techniques aim to create genetic uniformity by generating "copies" of plant, animal, or human genetic material. These copies could be cells with apparently identical genetic structure to the 'master' cell, or they could be entire plants, animals, or humans that are cloned from just one cell. The most notorious case of cloning experimentation so far came in 1997 with the announcement, by the Roslin research institute in Scotland, that they had cloned a lamb – named "Dolly"— from a single cell removed from the udder of an adult sheep.

Cattle cloning experimentation was already in full swing before Dolly was announced. Since 1997, regular announcements by institutes around the world claim successful cloning of other species, such as rhesus monkeys and mice. In 1997, a British newspaper reported that within 20 years, 85% of livestock in Great Britain could be clones.

> ***A respected commentator on the new genetics, Harvard biologist Ruth Hubbard explains how Dolly was made:*** *"What the Roslin scientists did was to isolate a cell from the stored, frozen udder of a long-dead ewe and fuse it with the egg of another ewe, from which they had removed the nucleus. Their special trick was to get this enucleated egg to incorporate the other cell's nucleus and "reprogram" it so that the reconstituted egg now functioned like an ordinary fertilized egg and formed an embryo. When this embryo was implanted into the uterus of a third ewe, it developed into Dolly." (p. xviii, Exploding the Gene Myth)*

How a transgenic plant is made

Once genetic engineers have identified the genes that they want to introduce to the agricultural crop, they construct a kind of package that will be introduced to the host agricultural plant. This package is made up of:

- *The* ***desired DNA (genetic material)*** *extracted from the isolated cell of the living being from which it is taken. (This is extracted using enzymes, proteins that function like scissors.)*
- *A* ***promoter****, that is a stretch of DNA, acts as a switch, ensuring that the foreign DNA is recognized and 'expressed' (employed to make the desired protein) by the host organism's cells.*
- *A* ***marker gene*** *is included, so that genetic engineers can tell if the foreign DNA has been successfully introduced into the host's cells. This gene most commonly confers resistance to antibiotics.*

To actually introduce this package into the targeted agricultural plant, two methods are commonly used:

- *A piece of bacterial DNA, called a plasmid, functions as a* ***vector,*** *which will be used to force the desired gene into the host organism. Vectors are most commonly viruses or bacterial plasmids because these function by breaking down the defenses in the host cells, and slipping into the cell's DNA.*

or

- *A* ***gene gun*** *is used. The gene construct is placed on large numbers of tiny gold (or tungsten) bullets and fired into a plate of target plant cells*

To make sure that the foreign gene has been taken up by the target organism, the cells are flushed with ***antibiotics****. The cells that are carrying the 'package' with the antibiotic resistance marker genes will survive. Those cells that do not have the package will not have resistance to the antibiotics, and will die. The surviving (transgenic) cells that are left will be cultured, and grown into mature plants.*

Many people, including some scientists, are concerned that the heavy use of antibiotics and antibiotic resistance in transgenics will have a harmful secondary effect of encouraging growth of harmful species that are antibiotic resistant. In recent years, there have been frequent reports of increased antibiotic resistance among human disease organisms.

General Concerns With Genetic Engineering

While the term "genetic engineering" sounds like an exact science, in reality it is far from being precise in any predictable manner. Critics of the technology, many of them scientists themselves, emphasize the unpredictability of genetic manipulation as a primary reason for caution. Critics say that the discipline lacks adequate knowledge of the many dynamic processes that contribute to the development and diversity of different plants and animal species in our world. They observe that the science is being developed and commercialized with too little concern for the risks of not knowing all of the consequences. Among the primary areas of concern, these scientists warn that:

- Transgenic techniques are imprecise. Currently, genetic engineers are not able to fully control where the foreign DNA is inserted into the host organism. This control is important because it is believed that the position of genes determines how they function.
- Genetic engineers are not being mindful of the environment of the gene, and the dynamic role that all the other processes and forces in a living being have in shaping the activities of genes.
- Genes can perform more than one function, depending on their environment and the influence of other factors. These multiple functions are not understood, but they are also largely being ignored. So scientists focusing on the 'growth genes' to make salmon grow bigger were surprised to find that the young fish also turned pale green. U.S. Department of Agriculture animal genetic engineers using foreign growth hormones to make pigs grow bigger produced pigs with severe arthritis, lethargy, and other disorders. Some of these multiple effects caused by foreign genes may not be so obvious at first, but instead may reveal themselves over time in previously unimagined ways.
- Projects for the development of genetically engineered plants and animals typically do not try to understand the way that the transgenic organism will interact with other species once released into the world.
- Genetics in general, and particularly genetic engineering, tend to be **reductionist**—assuming that everything can be explained in terms of genetics. Many other factors contribute to who or what a being is—such as nutrition, interaction with other species, and other environmental factors. Reductionism is a tendency of western science that is frequently at odds with the indigenous way of thinking about things in the big picture.

BIOPROSPECTING AND BIOPIRACY

Biodiversity: the basis of the genetics industry

The raw material of the genetics industry is life itself: micro-organisms, insects, plants, animals, and people. So the genetics industry is very interested in biodiversity and the diverse genetic material that exists in many indigenous communities and eco-systems around the world. The goal is to locate, in living beings, genes and properties that can be used to create new commercially viable products. The search for "interesting" or potentially commercially valuable genes and species is called **bioprospecting.**

Indigenous communities are a primary target of bioprospecting ventures by pharmaceutical and agricultural companies and government agencies. This is because 90% of the species on the earth are found in indigenous territories. As industrialization and monoculture have destroyed most of the biodiversity in the "developed" countries, the rich biodiversity that has been developed and conserved by indigenous peoples and rural communities is the new pot of gold.

Genehunters are also interested in indigenous peoples' **knowledge** about the properties of plants and animals, and their use in traditional medicines and agriculture. According to a US-based organization that is facilitating the gene-flow from indigenous communities to pharmaceutical companies, 74% of the plant-based medicines consumed in the United States are plant medicines developed and used by indigenous peoples. Pharmaceutical companies are going direct to indigenous communities and traditional healers to find the plants and traditional ways of using them, because researching traditional uses gives a 60% greater chance of identifying pharmaceutical potential than randomly screening plants. (Conservation International, from their website: www.conservation.org).

What is a Patent?

A patent is a title of ownership. Patents were designed to reward inventors for their contributions by guaranteeing them a period of market monopoly and exclusive market return. At the end of that period (usually 17-20 years) the invention is free from patent control, and is available to be produced and marketed by anybody.

A patent allows the holder

- **to prevent others from developing similar or identical products for commercial purposes**
- **to claim royalties for any profits that another person gets from selling the patented product**
- **to prevent others from selling identical products in the country or region in which their patent rights are valid**

Very often, agricultural and medicinal plants and animals are being taken from communities and indigenous territories without the knowledge of their peoples. And many bioprospectors have no intention of acknowledging the contribution or sharing the commercial benefits with the communities that have developed and nurtured these organisms. This is nothing new. Many of the world's major staple crops – corn, potato, soybean, rice, and wheat - were developed by indigenous peoples and rural communities. According to Clayton Brascoupe of the Traditional Native American Farmers Association, 65% of food crop varieties were developed by Native American farmers.

Privatizing Life: Patents on Life

Companies and government agencies that discover plants or animals of commercial interest in indigenous and rural communities often claim ownership over them. The most common and most effective route is to apply for a patent. This practice is a form of **biopiracy**.

Patents were developed by Thomas Jefferson as a form of "intellectual property law" to encourage innovation and invention. A patent is supposed to reward inventors: in exchange for the valuable contribution that inventors make to society, they are awarded a limited monopoly on the commercial rights to that invention. In order to reward useful contributions, the requirements for gaining a patent have traditionally included that the product has to be novel, and produced in non-obvious methods. Patents, however, were not intended for living beings, but for invented implements such as a toaster, camera, or combine harvester.

Criteria to receive a patent

Under United States law, patents can only be awarded for inventions that:

- *Are new to the public. They cannot have been in knowledge or use beforehand*
- *Involve a inventive procedure for their production, and add considerable knowledge to what is already known*

The application of this law is a different story. *See the "Impacts of Patents" box.*

Forms of private monopoly over life - agricultural seed and animals – began with the industrialization of agriculture, and led to the development of **plant breeders rights** to cover, for example, industrially hybridized crops**.** As the commercial exploitation of genetic engineering began to be explored over the last two decades, the patent system was stretched to include life forms and their parts. In the 1980s, two landmark cases in the US sealed the fate of life under US law: in 1984 a patent was awarded on a microbe, while in 1988, a patent was awarded on a genetically engineered mouse. Since that time, thousands of patents have been claimed and awarded on human, animal and plant genetic material as well as whole animals and plants. The US government, along with other industrialized governments and the genetics industry, has been pushing for a global agreement for patents on life.

Impacts of Patents

Companies and supporters of patents on living beings say that patents only claim property for an area of industrial activity that does not concern people or communities outside that industry. They say that patents therefore have little impact on the daily lives and concerns of society. Yet communities and societal groups that challenge the patent system name the following impacts on the real life of their constituents:

- Violation of the spiritual and political belief in the ultimate freedom of all living beings
- Violation of the spiritual belief in the Creator as the inventor of all life on earth
- Reward and encouragement of genetic engineering, biopiracy, and transgenic practices to which communities are opposed
- Theft of community property by individuals
- Theft from future generations of their rightful heritage
- Theft of livelihoods, as biopirates use patents to exclude farmers from the sale of agricultural products pirated from them

Increasingly, crops that were collectively developed by communities over generations are being privatized to genetics companies and scientific research institutes through patents. Monsanto, for example, owns patents on all genetically engineered soybeans, thanks to a single patent claim. Soya was domesticated and diversified in China. Corn, staple to millions, was first cultivated over 7000 years ago, and domesticated and diversified over centuries by the Mayan people. A varietyof patents on different corn are now held by seed companies around the world. In fact, all genetically engineered seed that is being tested and planted in our fields, and all genetically engineered foods in our shops, restaurants and supermarkets have been patented.

The flow of genes is primarily from indigenous communities and rural communities in ‘developing countries’ to the Northern-based genetics industry. Ninetly-seven of all patents are held by industrialized countries. (Action Aid, Crops and Robbers November, 1999).

Biopiracy and Biocolonialism: Plain Theft

In many cases, seed companies are claiming to be inventors of crops which they have not modified in any way, but which they have pirated from other communities. They may use some genetic screening to get a genetics-based description of the agricultural or medicinal plant, and simply use the language of genetics to pretend novelty and invention over something that has been common knowledge over centuries, even millenia. Examples of this practice include the patenting of the Indian neem tree, and Andean quinoa. (see box entitled, “Biopiracy Successfully Avoided”).

Increasingly, too, biopirate companies are analyzing the genetic makeup of exotic plants with large product markets. Their aim is to be able to create synthetic versions of the products that can be manufactured anywhere in the world. Companies like Mars, which produces chocolate bars, have taken extracted and patented properties of cocoa that is an important export market for West African farmers. Mars intends to cultivate the desired cocoa properties in its Northern-based laboratories. This can be seen as market piracy, because it destroys the livelihood of millions of farmers in different regions when they find that the market for their produce has disappeared.

In addition, the development of the **genomics** industry has accelerated the pace of private companies and governments seeking to geneticize and privatize life forms. Genomics is the study and mapping of all the genes of a given species and the way in which they interact in order to generate the characteristics of that species. For the human genome, this research began with joint public-private sector projects to map the human genome – the Human Genome Project (HGP) and the Human Genome Diversity Project (HGDP). The HGDP is targeted at mapping genes specific to indigenous peoples, and was quickly identified by indigenous peoples as counter to the interests, needs, and spirituality of its research subjects. Plant genomics projects – often heavily subsidized by governments – are being conducted on a number of the world’s staple crops, including corn and rice.

It is also likely that the communities from whom genetic resources have been pirated may find themselves forced to pay the same pirate companies for the newly introduced seeds that incorporate the traits stolen from them. Thereby, the cycle of theft and market exploitation in the gene flow from indigenous communities to GE companies is completed.

As plants and animals have been pirated from their communities, indigenous peoples have been forced to respond to protect the life in their territories and their traditional knowledge. In many cases, communities are finding out as much as a decade later that one of their sacred plants, animals, or methods has been patented. Some indigenous peoples have been developing mechanisms to protect collective community-based rights over plants, animals, human genetic material, and traditional medicinal and agricultural knowledge. Communities have also been challenging patents that have been awarded (see below). While these challenges have been successful on many occasions, they involve often costly and extremely time-consuming legal battles. Moreover, fighting off individual patent claims is an uphill battle when current patent law promotes biopiracy and the patenting of life. Nonetheless, indigenous peoples, progressive, grassroots farmers movements worldwide, and environmental and social justice movements in the North are all seeking to correct the flaws in the legal and governmental systems that have created this situation.

Biopiracy Successfully Challenged

Ayahuasca, of the Amazon Basin

In 1986, US citizen Loren Miller was awarded a US patent on the vine banisteriopsis caapi, the bark of which is used to make ayahuasca, a ceremonial drink used by many of the indigenous peoples of the Amazon basin. Ayahuasca is administered only by shamans, and is used in religious and healing ceremonies to diagnose and treat illnesses, to meet with the spirits, and to see the future. Miller claimed to have discovered a new variety of banisteriopsis caapi. The newness was the color of the flower petals. Miller claimed to have taken a sample of the vine from a domestic garden in the Amazon forest. He was intending to set up a pharmaceutical laboratory in Ecuador to process ayahuasca and other plants.

Eight years later, the Coordinating Body of Indigenous Organizations of the Amazon Basin (COICA) first learned of the patent. A further five years later, in 1999, COICA, together with the Coalition for Amazonian Peoples and their Environment, and the Center for International Environmental Law, successfully challenged the patent. They claimed that there had been no invention since the plant is used in an uncultivated state, and that the knowledge of its properties and uses had been developed and used by the indigenous peoples of the basin for generations.

Quinoa, of the Andes

In 1994, two University of Colorado researchers received US patent number 5,304,718 on quinoa - a high-protein cereal that has been domesticated in the Andes by farmers across Bolivia and Ecuador. The patent awarded the University researchers the title of 'inventors' of the quinoa, and exclusive control over the traditional Bolivian sterile male variety, "Apelawa", whose traits they intended to use in the production of high-yielding varieties for commercial-scale cultivation in Northern America. The patent covered all hybrids developed from male sterility cellular material from at least 43 traditional varieties. The researchers claimed that they would make the material available to researchers in Chile and Bolivia. Export markets for Bolivian and Chilean farmers were threatened, once the varieties are ready for commercial cultivation in the US. In 1998, the Bolivian National Quinoa Producers Association and an international support network were successful in forcing the researchers to drop the patent. Source: GRAIN, 1998, RAFI 1998

The Neem Tree, the 'free tree', of India

The neem tree is indigenous to the Indian subcontinent and is mentioned in Indian texts from over 2000 years ago. It has been used for centuries in agriculture as an insect and pest repellant, in human and veterinary medicine, and in toiletries and cosmetics. It is also venerated in the culture, religions, and literature of the region. In just a few years, over 90 patents have been awarded on the neem tree for its insecticidal, contraceptive, and medical uses. As in many cases of biopiracy and patenting, none of the patents are for genetically altered neem, but rather for uses already identified and shaped over generations. In May 2000, a challenge was successfully made at the European Patent Office against a patent on neem awarded by the US to the agrochemical giant W.R. Grace Corporation, on the fungicidal properties of the tree. The challengers included the Research Foundation for Science, Technology, and Natural Resource Policy, the International Federation of Organic Agricultural Movements, and Magda Aelvoet, former Green Member of the European Parliament and current Environment Minister of Belgium.

further info: **Rural Advancement Foundation International, http://www.rafi.org**

WHICH SPECIES ARE BEING GENETICALLY ENGINEERED?

Genetic engineers are mixing the identities of plants, animals, and humans for agricultural and pharmaceutical purposes. These are some of the transgenic experiments that have been done, some of which are now in products already on the market. Others are still in experimental phases. The table below summarizes some of the different experiments underway.

Species Crossed	Purpose	Who/Source
Snake venom in plants	Plants to produce poisons to protect them from insects	AstraZeneca
Scorpion venom in plants	Plants to produce poisons to protect them from insects	Agracetus/Monsanto
Human genes in sheep	Pharmaceutical products to treat emphysema	PPL Therapeutics, Scotland, with Selbourne Biological Services, NZ
Spider genes into goats	Goats to produce spider silk in their milk. Fibers to be used in bullet proof vests and anti-ballistic missile defense systems	Nexia Biotechnologies, Canada
Human growth hormone genes in pigs	To increase the meat yield of pigs	US Department of Agriculture, Beltsville facility, Maryland
Jellyfish genes into monkeys	Intermediate step. Ultimate goal is to insert human genes into monkeys for research into human illnesses	Oregon Primate Research Center at Oregon Health Sciences University
Human genes into Cows	To produce human-like milk	PPL Therapeutics (Scotland), with their subsidiary company in Virginia (US)
Extinct Moa bird genes into Ostrich	Revival of extinct species/larger ostrich meat yield	University of Otago, Aotearoa-New Zealand. Research cancelled due to indigenous opposition
Petunia and cauliflower virus genes into soybean	To make plants resistant to herbicide	Monsanto
Flounder 'anti-freeze' genes into potatoes, tobacco, and tomatoes	Frost resistant plants	Several research institutes

As the traditional boundaries of species are transgressed, the commercial function of plants, animals, and humans are changing. To follow is a more detailed look at what is being done to different forms of life in the interests of agricultural and pharmaceutical profits.

Plants

Crops that have been in the first line of engineering are the major market foods: cotton, corn, canola, potato, soybean, and tomato. The main field of interest is **agronomic** traits (how the crops will be cultivated) and how to capture and maximize the market for seeds, herbicides, pesticides, and fungicides. The main genetically engineered traits being commercialized are:

- Herbicide-resistance (plants that can be sprayed with herbicide and not die)
- Pest-resistance (plants that produce their own pesticide to kill insects)
- Fungal resistance (plants that kill problem fungi)
- Virus resistance (plants that are immune to, or kill, problem viruses)
- Seed sterility

In most cases, companies produce genetically engineered seeds that are resistant to their own brand of herbicides, allowing these companies to dominate the input market. 71% of the crops now cultivated and consumed are herbicide resistant. 22% of crops now cultivated have been engineered to be 'pest-resistant', with the insertion of a gene from a soil bacterium (known as *Bt*) that kills certain insects. The majority of genetically engineered crops such as soy and corn are being processed into animal feeds, but they also make their way directly into commercial food for humans. (For example, recall the Taco Bell taco shells recalled after it was discovered that they contained genetically engineered corn).

Transgenic vegetables are being developed, but none are commercialized yet. Meanwhile, rice and wheat are the subject of intensive research worldwide, and the race is on to get to the market first with genetically engineered varieties.

Increasingly too, the food or cash crops of developing countries are targets: plants indigenous to and commercially cultivated in developing countries for industrial country markets are being investigated. Often, the interest is how to modify these crops for their production in the laboratories or fields of industrial countries. This is the case with vanilla and cocoa bean, for example.

Which Genetically Engineered Crops Are in the (Official) Food Chain?

The US is the largest producer, exporter and consumer of genetically modified foods. People in this country have been exposed to genetically modified foods since 1996. The first crop to be approved for human consumption was a genetically modified tomato. There are now around 40 different crops that have been allowed into the food chain. These include:

Canola (3 varieties)	**Chicory**	**Corn** (14 varieties)	**Cotton** (5 varieties)
Flax	**Papaya**	**Potato** (3 varieties)	**Soy** (3 varieties)
Squash (2 varieties)	**Sugarbeet** (2 varieties)	**Tomato** (5 varieties)	

Due to field trials, it is possible that a number of other genetically engineered crops not (yet) approved for human or animal consumption, are nevertheless in the food chain. This is because of cross-pollination, and other natural processes by which plants reproduce.

More genetically modified foods are on the way…

There are around 3000 *field trials* underway throughout the US, where genetically modified plants are cultivated to see how successfully they will grow. These trials are currently self-regulated by the seed companies. The crops and plants under trial include:

> **alfalfa, apple, asparagus, barley, beet, belladonna, bermudagrass, carrot, chicory, chrysanthemum, coffee, corn, cotton, cranberry, creeping bentgrass, cucumber, eggplant, gladiolus, grape, grapefruit, kentucky bluegrass, lettuce, melon, oat, onion, papaya, pea, pear, peanut, pelargonium, pepper, petunia, persimmon, perennial ryegrass, pine, pineapple, plum, poplar, potato, rapeseed, rice, soybean, spruce, squash, strawberry, sugarcane, sunflower, sweetgum, sweet potato, tobacco, tomato, walnut, wheat.**

Overwhelmingly, these trials are focused on herbicide resistance and insect resistance, followed by virus resistance and fungus resistance. Around one sixth of the trials are of crops whose properties (taste or nutritional content) has been tampered with, in order to meet the production requirements of the food processing industry.

Where will we find genetically engineered foods?

Genetically engineered crops will enter into shops, supermarkets, restaurants, and fast food chains either as **whole foods,** or as **ingredients** in **processed foods.** In 1999, 33% of US corn was genetically modified, as were 50% of US soybean and 55% of US cotton. **Whole foods** include corn (on-the-cob and kernels), potatoes, tomatoes, and soybeans.

Processed or **ready cooked foods**, either as whole ingredients or processed ingredients, include genetically engineered:

- Vegetable oils and fats
- Starches (e.g., corn or potato starch)
- Additives such as soy-based lecitin. Aspartame sweetener is also produced through genetic engineering techniques.

Many of these foods are incorporated into thousands of processed foods. Soy, for example, is apparently incorporated in about 70% of processed foods.

People are also consuming genetically modified foods **indirectly**, through the consumption of products from animals fed **genetically modified feed.** Such animal products include **meats, dairy, and food ingredients such as gelatine**, through livestock fed on genetically modified feeds (e.g., with soybean, corn, cotton seed). Currently, none of these foods are labeled in the US.

"Terminator" and "Traitor" Technologies – Sterilizing Seed

How do we ensure seasonal seed markets? Make seeds sterile so farmers have to come back to the seed market every season? That's the answer that the US Department of Agriculture arrived at with Monsanto's subsidiary company, Delta & Pine Land Co. What are now called "Terminator Technologies" by outraged farmers and critics worldwide, are seed sterilization techniques designed to create a biological lock on genetically engineered crops, to prevent the plant from regeneration. That way, seed companies can ensure that farmers won't be able to use saved seeds in the next year's planting. So the technology has provided solutions to the large seed companies investing in genetic engineering of world staple crops – in particular rice, cotton, and wheat – who want a guaranteed continued **seed market** for their crops. Although worldwide farmers organizations, the ecological movement, development organizations, and many others have consistently condemned Terminator and similar seed sterilization techniques, the USDA, Delta &Pine Land, and other companies – Swiss Novartis and DuPont, for example - are continuing to develop them. USDA and Delta & Pine Land Co. have applied for patents on the Terminator in 89 countries worldwide.

The Terminator Technology involves 3 new genes for the process that makes the plant produce a toxin just before its own seeds mature, and which makes them sterile. To trigger this process, the seeds must be soaked in an antibiotic, such as tetracycline, before the seeds are sold to farmers at planting season.

A related, but younger, plant technology is "Traitor" technology. This technology involves using an external chemical to "turn on or off" genetic traits in plants. As an example, companies may try to "turn off" a plant's natural defense mechanisms, and thus make use of pesticides necessary to successfully grow the plant. The most obvious implication of this technology is an increased dependence on chemicals for agriculture. Other frightening implications also loom—like the possibility for applications in biowarfare. **The Terminator and some Traitor traits are carried in the pollen of the plants containing them, so the possibility of outcrossing into unintended species is a real danger.**

The Second Generation

A second-generation of genetically modified food plants is currently under development. Here the aim is to alter the nutritional content of plants. This second-wave is called "functional foods". This is, of course, empty marketing speak, since it suggests that the primary, ancient role of foods -- sustaining and bringing vitality to life -- is unimportant. (The industry also refers to this "new line" of crops as "nutriceuticals", "nutritionally enhanced foods", or "designer foods")

The major focuses of this 'wave' include: increasing the vitamin and mineral content of foods; modifying the fat, oil, starch, and sugar content; and changing or 'enhancing' the flavor of foods. The chemical giant DuPont, for example, is developing soybeans with modified oil levels. Foods are also being experimented with as 'delivery systems' for vaccines. This means that plants will be engineered to carry vaccinations, and are seen as a possible replacement to the administration of vaccines by injection or pills. With intensive funding by the Rockerfeller Foundation, the European Union, and the Swiss Government, researchers have been working on a rice that is supposed to deliver

Vitamin A to malnourished people. Companies such as Monsanto, Cargill, and DuPont are also developing lines of genetically engineered crops with engineered properties designed for high-density animal feed.

Bio-Industrial Materials

A third area of interest is the use of genetic engineering to create plants that will produce materials tailored more closely to industry needs. Major petrochemical companies, such as DuPont, are interested in plant genetics for this reason: as the day looms when fossil fuels will have been exhausted, petrochemical-dependent companies are desperately seeking to secure their survival. Plants provide the prospect of a renewable fuel source.

Forestry

Trees for fruit and forestry are now being genetically engineered for:

- **faster growth,** providing, it is claimed, a virtually endless source for pulp and paper
- **herbicide-, pest-, and insect-resistance;** reportedly to increase yield and minimize losses
- **salt tolerance,** so that trees can grow on soils that turn salty due to the pressures tree plantations put on water tables
- **altered day length perception,** so that trees can grow in a wider range of regions
- **altered fiber content**, that will reportedly reduce the amount of chemical treatment needed for paper and pulp production.
- **producing medicines,** after insertion of foreign genes
- **environmental clean-up,** where the trees are engineered to extract toxins from polluted lands

Trees currently under research include: **aspen, birch, chestnut, cottonwoods, elm, eucalyptus, herea, larch, pine, poplar, sandlewood, scots pine, black spruce, norway spruce, white spruce, sweetgums,** and **verticordi.**

The main companies involved are: Monsanto (US); AstraZeneca (UK, Sweden); paper companies such as International Paper; auto manufacturers such as Mitsubishi; oil companies such as Shell Oil; and logging, pulp, and paper corporations such as Fletcher Challenge (NZ), International Paper, and Westvaco. Field trials are currently taking places in countries such as Russia, Finland, UK, New Zealand, and the US. South East Asia is also under target.

Animals

Domesticated, agricultural animals – birds, pigs, goats, cattle and sheep – are all under experimentation. Transgenic experiments as well as cloning techniques are being explored to raise the production levels of individual

"A cow is nothing but cells on hooves"

Thomas Wagner.
Animal genetic "engineer".
Fortune Magazine, 1987

animals for dairy, meat, fiber, and other raw materials. Experimental projects currently focus on:

- faster growth, higher meat and dairy yields, increased wool production per animal
- virus 'resistance'
- mass reproduction of genetically modified animals
- The Terminator Technology involves 3 new genes for the process that makes the plant produce a toxin just before its own seeds mature, and which makes them sterile. To trigger this process, the seeds must be soaked in an antibiotic, such as tetracycline, before the seeds are sold to farmers at planting season.
- production of medicinal substances, such as "humanized" cow's milk for human infants, or milk designed to provide treatment for emphysema
- production of pig organs for transplantation into humans

In this sense, programs in genetic engineering of animals take animals further along the road to being seen purely as production units. A chicken with four legs (and no wings) is being created so that scientists can understand the way limbs develop. Reports by experts concerned with the welfare of farm animals show that the process of genetically engineering animals involves invasive and painful surgical activities, and results in many unexpected deformities, illnesses, and early deaths or slaughter, as scientists try out different transgenic combinations.

In the process of producing genetically engineered animals, scientists use a high number of animals as donors (of eggs, sperm, or cells), recipients, and foster animals. A 1998 report by a British farm-animal welfare organization estimated that 80 donor or recipient animals are used in the process of producing one transgenic cow, 40 donor or recipient animals for one transgenic sheep, and 20 for a pig. These animals may be subjected to any of the following: hormone injections to make them produce eggs, artificial insemination to fertilize eggs, surgical implantation to insert embryos for temporary motherhood, removal of embryos by surgery, by flushing the ovarian tubes, or surgical removal after slaughter.

Cloning

Perhaps the most famous example of genetic engineering of animals was Dolly, the cloned sheep. The news shot around the world when a British scientific institute announced in January 1997 that it had successfully "made" Dolly. The Roslin Institute scientists had fused a cell from the stored frozen udder of a long-dead ewe with the egg of another ewe, from which the nucleus had been removed. The scientists managed to get the egg to function like a normally fertilized egg. What the scientists did not mention was that at least 220 embryos were unsuccessfully tried before Dolly was born. Cloning technologies – building on those used to "produce" Dolly – are expected to be used widely to reproduce genetically engineered animals, with predictions of up to 85% of livestock in the UK, for example, being cloned within about 20 years.

No genetically engineered animals are ready for commercial release. Many projects are still in the experimental phase. Nevertheless, it has been revealed that in Australia and the United States, the carcasses of ‘experimental-level’ genetically engineered animals have already been used in processed foods for both animal and human consumption. Partly because the techniques are still being developed, many of the genetically engineered animals are born with or develop extremely painful health problems. According to INRA, the French agricultural research agency in Jouy-en-Josas (near Paris) describes the problems that afflicted a calf which was a clone of a clone. At seven weeks of age, it died of severe anemia after its spleen, thymus gland, and lymph nodes all failed to develop normally.

Genetic engineering is really better described as genetic *experimentation*, since the process is far too inexact to be called engineering. On average, only about 10% of mice and only between 1% and 4% of bigger animals like cattle or pigs successfully incorporate the foreign DNA into their genome. The remaining majority is either not transgenic or transgenic in an unintended way. These animals are generally killed after examination of their abnormalities.

Pharm-Animals: Animals that produce Pharmaceuticals

Animals are also being genetically engineered to produce substances that, it is claimed, will be used for treating human illnesses and health problems. In many cases, this involves inserting human biological material into animals. There are a large number of such projects underway. Genetically engineered animals that are being used for the production of pharmaceutical components are frequently called **bioreactors** or **pharm-animals.**

Here are some of the current experiments involving pharm-animals:

- Mice genetically engineered to produce human proteins in their semen. (The aim is ultimately to engineer to pigs to do the same thing, and to harvest the protein for commercial pharmaceutical purposes)
- Pigs are being genetically engineered so that their organs and tissue may be transplanted into humans (this is called xenotransplantation)
- Sheep are being genetically engineered to produce human proteins in their milk that could be used to treat people suffering from cystic fibrosis (an illness that usually manifests in childhood, and that involves the malfunctioning of the pancreas and disorders of the lungs). To this end, human genetic material is being collected, immortalized and inserted into sheep.

Xenotransplantation:

Pigs are being developed by companies such as Imutran (a subsidiary of Novartis) to act as organ donors for humans in need of organ transplants. They are genetically engineered to be “more human”, to reduce the human body’s rejection of the animals’ organs. Concerns around xenotransplantation include the creation and outbreak of new diseases – a virus that formerly affected only pigs, for example, but which could now successfully adapt to attack humans. A French virologist, Claude Chastel, has said it could lead to “a new infectious Chernobyl”. (The Observer, UK, 31/10/1999) Meanwhile, in the process to develop organ-donor pigs, a total of more than 10,000 pigs have been killed in the UK alone during research into animal-to-human transplants in the years 1996 to 1999.

Industrial Materials

Animals are also being experimented with in the hope that they will be able to produce industrial raw materials. In Canada, the company Nexia Technologies has inserted spider genes into a herd of goats, so that the goats will produce silky strands in their milk that the company hopes will be processed into the commercial product line called 'BioSteel' by 2001. The company claims that BioSteel will be used for surgical thread, bullet-proof vests, and potentially in anti-ballistic defense systems.

Other uses for animals include the genetic engineering of animals so that they will be better suited for laboratory experimentation for medicines and cosmetics. A collaboration between Harvard University and DuPont involved the genetic engineering of a strain of mice that will develop cancer and are programmed to die within 90 days of their birth. This so-called "onco-mouse" is designed for research into cancer, and was the first mammal in the world to be patented.

Genetically Engineered Fish

Fish are being engineered to grow larger and faster. They are also being engineered to need less feed, to be cold tolerant (to make it possible to introduce some species to colder areas than they could normally inhabit), or to be disease resistant. One of the major commercial programs underway is the US-Canadian company A/F Protein's "AquAdvantage salmon", into which A/F Protein has engineered the growth hormone from Chinook salmon. The engineered salmon is predicted to grow 4-6 times larger than ordinary salmon, and to need 25% less feed. A/F has 100,000 salmon in tanks in NewFoundland, Prince Edward Island, and New Brunswick, Canada. It is possible that genetically engineered fish meat will be released commercially as early as 2002, only one decade after most of the research began.

Other aquatic species that are being genetically engineered include: **abalone, Atlantic salmon, bluntnose and gilthead bream (bluegill), channel catfish, coho salmon, common carp, goldfish, killifish, largemouth bass, loach, medaka, mud carp, northern pike, penaeid shrimp, rainbow trout, sea bream, striped bass, tilapia, walleye,** and **zebrafish.**

Genetic Engineering and the Web of Life

The escape or deliberate introduction into the world of genetically engineered organisms places a number of threats and pressures on the web of life. Bitter experience shows us that the introduction of any new species will disrupt the existing life in that territory. The process of colonization around the world has introduced foreign species with disastrous impacts for the web of life in the colonized territories. The new species can compete with indigenous or other settled species for water, food, or sunlight, or it may change the nature of the food chain (such as the nutrients in the soils), threatening the other species that depend upon the relative stability and resource sharing in the ecosystem. Cattle, deer, rabbits, rodents, pigeons, and sparrows are well-known ecological problems where colonizers have introduced them.

Genetic engineering is a technology that is changing and “reshuffling” life into new forms that have never walked on earth before. Genetic engineering also relocates living beings and their parts (particularly viruses and bacteria, which are now a standard instrument of the genetic engineer’s toolkit) to places they have never been before. Now we will find scorpion venom, the *E coli* bacteria, human growth hormones, and antibiotics in species where they have never been. It is undeniable that these new species will disrupt the web of life, since each living being makes many contributions to the different nutrient and life cycles over the course of its life.

The introduction of genetically engineered life into the environment happens in one of two ways: **deliberate** or **accidental** release.

- ***Deliberate release*** is when genetically engineered life forms (usually developed in laboratories) are consciously introduced into the outside world for field trials, or in commercial release for their cultivation, breeding, and consumption. Deliberate release takes place on the basis of a government or regulatory decision. In some cases, deliberate release takes place when a genetics company introduces a genetically modified being into countries where there is no existing legislation around genetic engineering. This appears to have been the case in the newly independent countries of Ukraine and Georgia, where Monsanto’s genetically engineered potato varieties have been introduced without governmental knowledge or consent, and in the absence of legislation. (see Greenpeace reports)
- ***Accidental release*** is when genetically engineered organisms or their parts escape into the environment as a result of negligence, accident, or human error. As an example, when natural forces such as the wind and feeding birds spread pollen or seed beyond the confines of test fields or trial enclosures. Emissions of fluids and waste from laboratories developing genetically engineered organisms are a constant source of genetic pollution that could be termed negligence, due to the wholly inadequate attention or regulation around such day-to-day releases. Genetically engineered seed can be accidentally mixed as a result of inadequate segregation of seed stocks.

In both cases, we can expect that the consequences of genetic engineering will extend well beyond their targeted location. This is because genetic engineering is dealing with living beings, and life is dynamic—it encompasses motion, interaction, reproduction, and recreation. Genetically engineered microorganisms, plants, and animals are life forms that become part of the natural order, integrating into the web of life, interacting with the many other insects, plants and animals. *They cannot be contained by fences, or by barriers.* Releasing into the wider world genetically engineered living beings, whose impacts on other living beings we do not fully understand, is an irreversible act. This act is sometimes referred to as **biological pollution.**

The potential risks to other species and the web of life include:

- **the direct toxicity of genetically engineered organisms to wildlife**
- **the transfer of genes to native species either deliberately or inadvertently**

Initially the genetics industry and governments that support it sought to deny any disruption or harmful ecological effects. After sustained pressure, government and industry have retorted that the benefits of the genetic engineering outweigh any risks it poses. On the basis of concerns and new findings, however, it is clear that genetic engineering poses huge and long-term risks to the web of life. These risks result from:

- technical problems with the technology itself
- the introduction of new species and the risks associated with the **exotic genes** introduced into the transgenic life forms
- use of the technology to continue intensive agriculture

At the base of genetic engineering in agriculture is a reductionist, narrow vision of the complex processes, interactions, and interdependencies that create and sustain life. Genetic engineering misrepresents and overemphasizes the role of genes in this process, and, it seems, almost completely loses from view the whole web of dynamic forces at play, of which genes are only a part. It ignores the huge role that the rest of the environment, including interaction with other species, plays in the life of any individual creature.

An agricultural system that is obsessed and oriented around a narrow conception of life processes is unstable and unpredictable. So it is not surprising that entirely unexpected events occur around introduction of genetically engineered species into the environment. It is not surprising that the laboratory development, release into the environment, and commercial cultivation of genetically engineered organisms are threatening the web of life, and within that, the food systems that sustain human communities around the world.

Agricultural genetic engineering, as it is currently being developed, is single-mindedly focused on the a few genes in the crop to be cultivated. The diversity of eco-systems, which have over centuries determined what crops can be grown in which regions, and under what conditions, and by whom, are purely technical barriers to be overcome, with little or no regard for the communities, other plant and animal species, and natural resources that will be impacted by the introduction of wholly novel plant and animal life.

Safety Risks

Genetic Engineering is Imprecise and Random

From **a technical perspective,** many scientists critical of the development and orientation of genetic engineering point to the imprecision and crudeness of the techniques being used to create new life forms.

The way that genes work is largely determined by where they are located on the long strands of DNA. The order and spacing of genes is crucial to their proper functioning and interaction. The same gene will function differently at different places in the organism. Genetic engineering disrupts this natural order. Genetic engineers are unable to accurately control the place where the new genetic material enters the organism. In one genetic manipulation technique, "gene guns" blast foreign DNA into plant cells. The foreign DNA is placed on microscopic "gold bullets", to be taken up **wherever in the cell the DNA lands.**

Furthermore, current genetic engineering practice tends to understand genes in isolation, and as performing **singular** functions. Yet these functions may be plural, as well as differ, dependent on position and interaction with other genes in the organisms, as well as events in the wider environment. For example, young Atlantic salmon engineered to grow faster were also pale green, and turned silver – the color of maturity – six months earlier than usual, and without accompanying sexual maturity. (WEN, Giant Green Salmon and Aquaculture, 1995).

Use of Viruses, Bacteria, and Antibiotics in Genetic Engineering

Crude techniques are currently used to force foreign genes into a life form, which each carry their own set of ecological harms. **Viruses** are used like advance troops to force the 'host organism' to accept the foreign DNA, by breaking into the host's cells and depositing the foreign DNA there. **Bacteria** are used to carry the new genetic material into the host organisms. It is feared that the viruses and bacteria used could **recombine,** to form new and powerful viruses and bacteria, whose effects cannot be predicted, and against which we may have no defense.

Concern over horizontal gene transfer, transfer to other organisms, of a virus used as a promoter in genetic engineering of plants has already prompted some respected scientists to call for a ban on releasing plants containing the Cauliflower Mosaic viral Promoter (CaMV). CaMV is known to transfer horizontally, and there is concern that it could reactivate related viruses in species other than those into which it was placed, particularly viruses closely related to it, or cause other unknown genetic problems in other species. Of special concern is the fact that human Hepatitus B virus is closely related to CaMV. CaMV is already included in many genetically modified plants, so the danger could be imminent.

There are similar concerns about the creation of plants and animals that are genetically engineered to be immune to certain viruses. In spite of such concerns, Monsanto's "NewLeaf PLUS" potato, which is engineered with leafroll virus genes, has been commercially cultivated in huge tracts in the US since 1997.

Genetic engineering isn't the only way to create virus resistance in plants. For example, cassava (an important staple crop in Africa, the roots of which are used to make bread and tapioca) virus resistance has been successfully created by traditional selective breeding of naturally resistant plants, and by-passing the risks of genetic engineering. Still, companies are planning to develop and market genetically engineered, virus resistant cassava.

Antibiotics are used to indicate whether the "host organism" has accepted the foreign DNA. The use of antibiotics for this purpose is widely criticized because antibiotics are precious defenses for humans and animals against harmful bacteria. There is increasing concern that when humans consume plants with antibiotic resistance genes, the resistance may be passed on to bacteria in the human digestive system, and from there on to other bacteria. This could lead to bacteria that are **resistant to antibiotics.**

Engineering Monoculture and Intensive Farming

Half a century of intensive agriculture in the US has had disastrous effects on the environment and community health. The development of monocultural (one-crop) farms and the use of intensive agrochemicals to fight off the pest populations that thrive on monocultures has vastly reduced agricultural biodiversity, devastated surrounding wildlife (plants, animals, and soil ecology), and poisoned groundwater, farmers, and communities.

Most genetically engineered products out on the market or close to market approval are designed to maintain industrial agriculture's use of chemicals and **monocultural** cultivation. Genetic engineering, therefore, focuses on altering the plants and animals to better cope with the chemical and biological stresses. This includes making plants:

- **resistant to herbicides,** so that the agrochemicals can be spread liberally over the cultivated crop without killing them
- **resistant to pest insects,** by producing the toxins that will kill pests
- **resistant to diseases**
- **tolerant of adverse environmental conditions** such as drought, salinification, and frost

Genetic engineering is also being used to push plants and animals beyond their natural limits, in order to produce higher yields of commercial raw materials. This means increasing the productivity of each individual animal (more meat, more wool, more milk, for example). The damages wrought on the life beyond the field are only superficially addressed. In this sense, genetic engineering is **not** a revolution in agriculture.

By far the most widespread commercialization of genetic engineering involves plants engineered to be herbicide- and pest-resistant. In 1999, 71% of genetically engineered crops planted worldwide were herbicide resistant, while 22% were pest-resistant (This should come as no surprise given that the giants of the genetic engineering industry are also giants of agrochemical and agricultural inputs sectors.)

Herbicide resistant crops are engineered to survive application of herbicides. In most

Mono-Forests and Genetic Engineering

Traditionally, commercial forestry has created a host of ecological stresses – from agrochemical pollution to desertification. According to scientists at the Women's Environmental Network in England, current commercial genetic engineering projects do not address the root problems of commercial forestry, such as monocultural production. While companies such as Monsanto, International Paper and Fletcher Challenge call their genetic engineering programs 'ecological', they are designed for use in monoculture. Salt tolerance is being explored to create trees that can survive the salinification that is resulting from trees that are genetically engineered for faster growth. This is because plantations of fast-growing trees drain and deplete the soil of nutrients faster than microorganims can replenish them, causing salt to build up in the soil.

(Womens Environmental Network: Gene Tech Trees, 1999) cases, companies are making plants resistant to their own herbicides, and require farmers to use only the company's herbicide with the plant. While companies such as Monsanto and AgrEvo claim that farmers need to apply herbicides less frequently, and use less herbicide overall, there is evidence that points to the contrary. Meanwhile, companies are increasing their herbicide production capacity to meet the growing demand. Commercialized varieties of herbicide-resistant crops include Monsanto's Ready Roundup Soy, Beet, Cotton, and Corn, and AgrEvo's Liberty Link Corn.

"Before we engage in accelerating the arms race against weeds and pests, we should consider if a war waged on nature can produce a sustainable agriculture for future generations".

Dr. Ricarda Steinbrecher,
Genetist Econnexus

Pest-resistant plants are engineered to produce toxins that will kill pests. The most common insect resistance has been developed using a soil bacterium called *bacillus thuringiensis* or **Bt.** Bt has been used as a spray for decades by organic farmers as a form of biological pest control. Whereas organic farmers spray the Bt pesticide periodically, the Bt-plant produces the toxin constantly. Commercialized varieties of Bt plants approved for consumption include: Monsanto's Bt cotton, corn, and potato; Novartis' Bt corn; and Pioneer Hi-Bred (DuPont) Bt corn.

Are the Crops Living Up to the Promises?

GE seed companies have made a number of claims about the performance and sustainability of their herbicide and pest-resistant crops.

GE companies CLAIM that less herbicide and pesticide are needed, BUT studies don't agree:

- ***Results from 8,200 university field trials in the US show that farmers growing genetically engineered soybeans use 2-5 times more herbicides than farmers growing non-genetically engineered varieties. (Reported: Greenpeace USA)***
- ***US Department of Agriculture research into the performance of herbicide-resistant and insect-resistant crops in 1997 and 1998 show mixed results.***

In some regions, farmers could use less herbicide, but in others, farmers were using similar amounts as with conventional crops.

In the Missisipi delta region, farmers were using 53% more pesticides, because not all corn and cotton pests are affected by the Bt toxin that is engineered into the crops.

(Source: Genewatch Report, A Review of Developments in 1999, and USDA report)

Killing More Than the Target Pests

Genetically engineered pest-resistance is proving to be short-sighted, because it addresses the pests in isolation from the wider environment and their position within the food web. Evidence from studies shows that the toxin-producing plants kill not only targeted pests, but other insects that do not affect the harvest. In some cases these other insects are beneficial to farmers.

- Potatoes were genetically engineered with the protein from the snowdrop, in order to research its effects in repelling aphids. Researchers noted that natural pest-control provided by ladybugs and other natural predators of aphids would still be necessary.

However, it was found that the life-expectancy of ladybugs feeding on aphids that had eaten the genetically modified potato was halved, and that the reproduction of ladybugs was severely affected. (Scottish Crop Research Institute).

- The pollen from insect resistant plants can kill other non-target insect life. This was discovered during a study conducted by Cornell University. The researchers found that Monarch butterfly caterpillars suffered high mortality rates when pollen from the insect-resistant corn blew onto milkweed – the food of the Monarch. Milkweed is a common border neighbor of corn. The Monarch butterfly does not affect corn.

Herbicide Resistance

Resistance in plants to broad-spectrum herbicides also has the potential to devastate other parts of the food web. When the food crop is genetically engineered to survive the herbicide, the whole field can be sprayed with the herbicide, including the crops themselves. This means that all other plant species that live in or bordering on the field will be killed off, destroying the food source for beneficial farmland wildlife such as birds and insects. In Great Britain, the Royal Society for the Protection of Birds has called for a moratorium on the release of herbicide-resistant plants.

> ***"The ability to clear fields of all weeds using powerful herbicides which can be sprayed onto GE herbicide resistant crops will result in farmlands devoid of wildlife and disaster for millions of already declining birds and plants."***
>
> Graham Wynne, Chief Executive Director,
> Royal Society for the Protection of Birds, UK

Threats to Wild Relatives

Other forms of genetic engineering such as the introduction of growth hormones from other species to increase the size of animals may also kill off related species when the genetically modified animals interbreed with non-genetically engineered relatives.

Purdue University research discovered that **growth-enhanced fish** (fish genetically engineered to grow larger, quicker, to increase meat yield) would be able to eradicate a large population of wild fish. The GE fish have a mating advantage, which means that they would transfer the genetically engineered trait, leading to offspring with less chance of survival. (Greenpeace International, January 2000)

What this further illustrates is that there is very little understanding of real-world ecology applied to the development and regulation of genetically engineered crops.

Introducing New Species

Genetically engineered crops are considered to have a fitness advantage, particularly where they have been engineered to resist the local populations of insects or weeds that are considered pests. This fitness advantage is high risk to surrounding diversity where genetically modified organisms are released into **centers of origin and diversity.** These are areas where the domesticated crop has been developed, often over centuries, and where there are diverse agricultural and wild relatives. Where GMOs have wild or domesticated relatives, the risk of

outcrossing is high. Outcrossing is where there is an exchange of genetic material, such as through pollen flow, which transfers the genetically engineered traits into the domestic or wild varieties. When these varieties with the transferred genes reproduce, new varieties develop that may take over the habitat of the original varieties, and have unknown impacts on other species that feed off these new, accidentally changed varieties.

- **Genetically engineered corn** is being grown extensively throughout the US, and is under field trial in Mexico. Yet Mexico is the center of origin and diversity of corn. Corn is central to the Mayan peoples, who have cultivated and developed corn over thousands of years. The 5000 corn varieties that form their staple diet, are imperiled, as are the culture and life of the people. The amount of traditional corn varieties have been reduced by the replacement of traditional varieties with industrial seed in the last decades. Since the 1930s, 80% of the traditional corn varieties have disappeared from the fields. Now remaining varieties are threatened by the deliberate introduction of genetic engineering as well as the accidental destruction of varieties by outcrossing. (Greenpeace)

In the US, Monsanto's genetically engineered, "Bt" cotton is sold with the instructions:

"In Florida, do not plant south of Tampa (Florida Route 60). Not for commercial sale or use in Hawaii".

This is because of the wild relatives of cotton in both areas *(Gossypium tomentosum* in Hawaii, and *Gossypium hirsutum* in Florida).
In both cases, free exchange of genetic material with cultivated cotton is possible. So the US Environmental Protection Agency asked Monsanto to keep the cotton out of areas where close relatives grow.

- **Potatoes**: 5000 varieties are cultivated worldwide, 3000 of these in the Andes. Currently, Monsanto is experimenting with genetically engineered potato in the Andes, with a view to introducing its potato for commercial cultivation. (Greenpeace International, Centers of Diversity, p.33) Meanwhile, the Belgian Ministry for Development Cooperation has funded Plant Genetics Systems (now a subsidiary company of the Aventis group) to introduce Bt-pest resistant potatoes to the Andes.

Pollen drift and outcrossing — some examples:

- *Canola is a member of the brassica family, which has its center of diversity in Europe. Cultivated canola has been shown to spontaneously hybridize with wild relatives in Europe. The seeds have a high seed dormancy, and can germinate several years later. There is great variation in studies of canola pollen drift, and outcrossing of genetically engineered varieties with wild or conventional canola. Some studies show that there is a 1.2% chance of GE canola outcrossing as far as 1.5 km from site of cultivation. Others show a 0.1% chance at a distance of 1 km from the site. (Centers of Diversity, Greenpeace International)*
- *In the British Isles, pollen was discovered on the treeless Shetland Islands. It is believed that the pollen traveled from forests more than 250 km away. (Source: New Phytologist 72: 175-190 and 6901-697). Meanwhile, in North-West India, pine pollen was found 600 km from the nearest pine trees. (Source: New Phytologist 72: 191-206)*

- *In the US, cultivated sunflowers hybridize with some related native species. Swedish researchers found a 15% outcrossing rate, even at 200 meters from the cultivated sunflowers. 1000 m from the cultivation, the rate drops to between 0-2%. In the US, an isolation zone of 6.4 km is recommended to protect commercial sunflower seed nurseries from unwanted wild sunflower pollen. (Source: Arias Dm, Rieseberg, LH (1194) "Gene Flow between Cultivated and Wild Sunflowers." Theoretical and Applied Genetics 89: 655-660. Cited in: Greenpeace International Report, Centers of Diversity, 2000.*
- *A Friends of the Earth Study, carried out in cooperation with the National Pollen Research Institute and the Austrian Federal Environment Agency, showed that bees carried pollen from genetically engineered canola as far as 4.5 Km away. 2 out of 9 pots of honey from shops near genetic engineering field trials revealed traces of genetically engineered pollen. The UK Government currently requires a 50 meter separation distance between genetically engineered crops and other fields. As a result of this, the British Bee Farmers Association has advised itse members to ensure a separation distance of 6 miles from any trial site. (Source: Friends of the Earth Press Release, September 29, 1999)*
- *Self-pollinating plants also cross-pollinate. In September 1998, University of Chicago researchers discovered that a mutant variety of mustard Arabidopsis thalania was 20 times more likely to outcross than naturally occurring mustard varieties that are resistant to herbicides. (Source: "Biotech Goes Wild", Technology Review, July/August 1999)*

Outcrossing can create Superweeds and Superbugs…

Outcrossing could also lead to the development of wild relatives that inherit herbicide, insect, or virus resistance. For farmers, this could mean whole new varieties of weeds that are resistant to the weed control they use. Farmers will then have to use even stronger weed control agents, which are more toxic to the farm workers, the soils, groundwater, and other species, and are more expensive for the farmers. Already, it is feared that the widely commercialized Bt insect-resistance, which has been incorporated in to diverse crops such as potato, corn and cotton will quickly lead to increased insect-resistance.

"Company spokespersons commonly state that no negative impacts on the environment have been observed – which is an obvious result considering that no one has been seriously looking for them."

Dr Ricarda Steinbrecher,
Geneticist, Econnexus (UK)

It was only after approval for commercial release was given, and after concerns were persistently raised by farmers organizations and ecologists, among others, that some attention was directed to insect-resistance. A scientist from the University of Minnesota believes that farmers wanting to use the Bt insect-resistant crops will have to plant 60% genetically engineered and **40% non-insect resistant,** in order to stall total insect resistance until 20 years from now. (Farmers Weekly, 9/99)

Contamination of conventional seed stocks

Following are some examples of contamination of conventional seed stocks by genetically engineered seeds. These cases have only been revealed because they were uncovered by campaigning organizations. It is safe to assume that this is only the tip of the iceberg.

- *In May 2000, Canadian canola seed sold in Europe by the company Advanta was found to be contaminated with genetically engineered canola. According to the French Press Agency, 600 hectares were sown in France, 400 in Germany and 500 in Sweden. In the UK the seeds have been sold for the past 2 years, and 500 to 600 farms have been affected. A total of at least 15,200 hectares may have inadvertently been planted with GE-contaminated crops in Europe. France had placed a ban on all genetically modified crops with wild relatives in the country. (Source: Greenpeace, Friends of the Earth)*
- *In March 2000, Greenpeace revealed that 2 out of 7 samples of US cottonseed sold in Greece were contaminated and a third one had a strong indication of contamination. The genetically engineered cotton is not approved for human consumption in the European Union, and it contains an antibiotic resistance gene. 60-70 per cent of the Greek cotton harvest is used for the production of cotton oil and animal fodder. (Source: Greenpeace International press release, March 2000)*
- *In 1999, Pioneer corn seed being sold in Germany, under the brand name "Benicia" was shown to be contaminated by two genetically engineered varieties that had not been authorized for cultivation in the European Union (EU). Preliminary tests on three sacks of Pioneer Hi-Bred corn had shown that genetically modified seed were present in small quantities, despite the fact that no varieties of Pioneer genetically modified corn had yet been approved by the EU. Contamination of the seeds, which were harvested in the United States, was "probably caused by stray pollen during the growing season," says Ulrich Schmidt, managing director of Pioneer in Germany. (Friends of the Earth, May 1999)*
- *November, 1997: A test batch of Monsanto genetically-modified sugar beets was mistakenly sent to a Dutch refiner and mixed with normal sugar. Genetically modified sugar beets from a test farm were sent to a CSM plant, and mixed with normal beets.*

Field Trials

According to critics of the approach to safety testing, risk assessment and regulations, field trials are not designed to pose many of the important questions on the impact of transgenic organisms on their new environments. Only a limited number of trials are set up to look at gene flow, hybridization and environmental impact. The trials are mostly designed to study only the performance of the crop. This criticism challenges the claims of US government officials and genetic engineering companies, that genetically engineered foods are the "most tested foods ever". See Chapter 7 for more discussion on Health and Safety Testing.

How genetic engineering of plants and animals are accidentally entering indigenous communities

Genetic engineering is the business of manipulating and distorting life forms. Life is dynamic motion and interaction, reproduction, and recreation. Genetically engineered microorganisms, plants, and animals are life forms that become part of the natural order, integrating into the web of life, interacting with other insects, plants, and animals. They cannot be contained by fences, or by barriers. Releasing into the wider world genetically engineered living beings, whose impacts on other living beings we do not fully understand, is an irreversible act. Even when these plants and animals are kept in laboratories and factory farms, it cannot be guaranteed that modified genetic material will not escape, and become part of the living world, with unknown consequences for other life forms and the web of life:

- ***Carried by the wind, by riverways or animal-born,*** *the pollen or seeds of genetically modified plants and trees are transported across distances. They cross fertilize, cross-pollinate, and germinate like all other living beings.*
- ***Streams, rivers, lakes, oceans: genetically engineered fish*** *may escape from their captive breeding places and into the wild. It is currently estimated that even a few genetically engineered fish could replace an entire population of wild fish, due to natural spreading of their introduced traits.*
- ***Genetically modified crops*** *that have been approved by federal agencies enter into a wide range of processed foods. Living food entities like potatoes can reseed, if composted before use, while foods such as tomatoes, corn kernels, and cereal grains that are still viable seeds can pass intact through digestive systems and then out again into the earth.*
- ***New bacteria and viruses*** *that result from the processes of genetic engineering, and from the new life forms that they create, may enter into diverse ecosystems with the force of epidemics.*
- ***Animal feed*** *used to supplement diets of domestic livestock can contain genetically engineered ingredients.*
- ***Wild bees and butterflies*** *may take pollen from genetically engineered crops that are deliberately cultivated or that have escaped from the fields.*
- ***Wild animals that are hunted for food*** *may have consumed genetically engineered crops from cultivated fields. Birds, for example, may have eaten seed from cultivated genetically engineered crops or escaped genetically modified plants.*
- ***Birds of prey*** *that eat small wild animals that have fed on genetically modified crops will also be vulnerable to the unknown effects.*
- ***Genetically engineered crops*** *cultivated in or near regions where there are domesticated and wild relative varieties (i.e., that are centers of origin or centers of diversity for that crop) are likely to exchange their genetic material, including the genetically engineered traits, and thus become part of the wider environment. Over time, and with increased exposure to the presence of genetically engineered plants and microbes, seeds of sacred lineage and non-cultivated traditional medicines may be contaminated, disrupting their identity, and bringing as yet unforeseeable changes to their medicinal properties.*

COMMUNITY CONCERNS: FARMERS, FOOD, AND CULTURE

The genetic engineering seed companies are trying to replace farming cultures across the world with genetic engineering agriculture. They want farmers to stop using their traditional seed and their traditional cultivation practices, and to use the genetically engineered seed packages that they, the companies, are putting on the market. In this way, these companies are **biocolonizers.** They claim that the variety of seeds that have been created and are used by small-scale and peasant farmers in Southern countries are out-of-date and ineffective, and that their high-technology seeds are the best – in fact the only - answer. They suggest that the reason people are hungry in many countries is a **seed-problem.** Their vision is to **replace** the farmer-developed diversity in fields throughout the world with their own seed. Senior-Vice President of Technology of the company that has developed the Terminator Technology puts it in a nutshell: "The centuries-old practice of farmer-saved seed is really a gross disadvantage to third world farmers who inadvertently become locked into obsolete varieties because of their taking the easy road and not planting newer, more productive varieties." Harry Collins, Delta and Pine Land Co. (Monsanto). In reality, however, what the corporations really are seeking are new markets for their seeds, and they use the plight of starving people as an excuse to gain a market hold.

Loss of Biodiversity

Fact File

- *UN Food and Agriculture Organization estimates that we have lost 75% of our global crop diversity in the 20th Century.*
- *More than 34,000 species worldwide (12.5% of all the world's plant life) are facing extinction*
- *Every higher-order plant that disappears takes at least 30 other species with it (insects, fungi, bacteria)*
- *Livestock diversity may be eroding at the rate of 5% yearly (6 breeds every month)*
- *The US has lost more than 80% of its vegetable seed varieties since 1904. Currently around 29% of all species still in the US are threatened.*
- *In just 50 years, China has lost more than 90% of its traditional wheat varieties*

RAFI, the ETC Century,
Greenpeace Centers of Diversity Report
and the WorldWatch Institute 1999

Agribusiness is, at the bottom line, business. It does not recognize or value the necessity of community sovereignty over food and agriculture as a prerequisite for food security and community stability. So it does not recognize that the continuing replacement of community-led agriculture and nutrition, the replacement of traditional practice and varieties with agribusiness-led practices and varieties erodes communities, cultures, food security, and ways of life. It does not respect the place and role of farmers in cultures and communities. It places no value on how farmers nurture, select, grow, and safeguard food crops as the wealth, and heritage of a community and its values.

Many indigenous and small-scale farmers are not part of the globalized economy and their territories may still lie beyond the destructive reach of industrial agriculture, and thus be home still to diverse, bountiful nature. There are 1.4 billion small-scale farmers in the world that are the protectors and nurturers of a large part of the diverse plant and animal life that "stands between us and catastrophic starvation on a scale we cannot imagine" (Cary Fowler, Pat Mooney: 1990). Increasingly, the genetic engineering seed companies are interested in how to capture these potentially huge markets. One problem that they have faced is **seed saving.**

Seed-saving is one of the many practices of farmers that ensures a wide diversity of seed to select from, in constant response to the constantly evolving ecosystems in which they cultivate. It provides the basis for the living diversity that is interwoven into the cultural and spiritual life of their communities. It is a practice that enhances and guides the true wealth of any people – seed saving assures regeneration and renewal of life.

> ***'It amounts to a declaration of war against the 1.4 billion people who depend on farm-saved seeds -- mainly poor people -- and it's an assault on global food security,'***
>
> Rafael Alegria, General Coordinator of Via Campesina, the largest confederation of peasants' and small farmers' organizations in Africa, Asia, Latin America, Europe and North America.

For agribusiness, seed saving is about loss: loss of markets. If farmers save seed, they may not come back to the seed-markets every season, but only when they are interested in the properties of plants available on the markets. **Seed sterilization technologies** are the seed companies' answer to this problem, since through this strategy farmers are **forced** by the death of the regenerative powers of plants, to return to the markets. For crops like rice, this is particularly important. 80% of rice seed in Asia is farm-saved. (In: "Genetech Preys on the Paddy Field, *Seedling,15*/2 1998) The "inventors" of one of the seed sterilization technologies (the "Terminator") made very clear that it is a technology that makes it interesting for agribusiness to move into farming communities in developing countries. Terminator will **"increase the value of proprietary seed [seed under patent] owned by US companies and to open up new markets in second and third world countries". (US Department of Agriculture).**

The Friendly Face of Genetic Engineering

Since 1997, genetic engineering companies have been accused by small farmers and environmental and food-security organizations of trying to trap and enslave small farmers and peasants into high-cost agriculture and dependence on the seed and chemical companies. They are accused of developing an agricultural system that in no way responds to the needs of small farmers and rural-based communities. They are also accused of developing strategies to impose this destructive agriculture on these communities. In response, these companies are developing new programs that they say answer their critics. Following are some of the strategies the agri-giant corporations are using to cloak their intentions.

How Small Farmers May Be Approached

Small soft loans to the resource-poor: Monsanto and other agribusinesses are involved in a number of programs designed to extend small credit to the very poor in developing countries. It is not clear what the terms of the contracts are in some of these cases. Concerned at how the hidden agenda might be to get small-farmers to use genetically engineered seed, small-farmers and non-governmental organizations in Bangladesh protested the partnership between Monsanto and the Bangladesh micro-credit bank, Grameen. As a result, the head of the bank cancelled the collaboration.

Gift offers: Free use of technology Companies such as Monsanto are offering some of their technologies "free" to small and subsistence farmers. One example is a technique that the company claims will increase the level of nutrients such as **beta carotene** in the oils from genetically engineered crops. While Monsanto is donating the technology free, US Government resources will be used to transfer this technology to the targeted communities. These are resources that could be used to support local diet and food security in another way than bringing a high-risk technology that will probably not address the real needs of the communities. Furthermore, it is not clear how long the 'free offer' lasts, and when the company will start charging farmers for seeds on which they have grown dependent.

A University of Missouri study commissioned by the US National Farmers Union reported that "four or five clusters will develop with numbers limited by access to biotechnology rights. . . . [these clusters] will dominate world food production in the future, deciding who eats and reducing farmers to day laborers."

Source: Consolidation in the Food and Agriculture System. Report prepared by Dr. William Heffernan, Department of Rural Sociology, University of Missouri. February 1999

Emergency aid: US food aid packages – some of which may come through the World Food Program – are increasingly likely to include genetically engineered seed and foods. Recently, the US development agency US AID admitted that stocks of corn that were sent as emergency supplies to disaster areas around the world were partly genetically engineered. This stream of supply of genetically engineered viable seed material is government-funded, and may generate a cycle of small farmer dependency. If agribusiness is successful in introducing genetic engineering into less-developed countries and indigenous communities, the generosity and the free deals may end, and industry will drive a dirty deal, like it does in the industrialized world.

In the industrialized countries, indigenous farmers that are growing for large export or domestic markets are under great pressure to use genetically engineered crops because of the incentives the cost-cutting and economic advantages the genetics companies promise. There is currently a real lack of agreement about whether the genetically engineered crops on the market are keeping their promises.

A New Breed of Agriculture

Many farmers are calling the new hierarchical, policing relationship that the seed companies are trying to build with farming communities "**bioserfdom**". Monsanto is placing farmers under tight financial-legal restrictions for growing genetically engineered seed. It is also making farming communities bear the economic and ecological risks of their new technologies. If you are a farmer wanting to use Monsanto's genetically engineered seeds, you may have to sign a contract in which you:

- promise not to save any seed
- promise to use only the herbicides or pesticides that Monsanto says you can use
- agree that Monsanto inspectors can come and inspect your farm any time they chose to check if you are holding to the contract conditions
- agree to keep farm records for a specified period

Monsanto is currently investigating 475 farmers in the US, whom it charges with **illegally** saving seed. The company has set up reporting structures that encourage farmers to report on other farmers that they believe are saving the genetically engineered seed. It is using a private detective firm to investigate what it refers to as **seed piracy.** The most high-profile case involves a farmer from Bruno, Saskatchewan. The farmer, Percy Schmeiser, is fighting Monsanto's charges of pirating the company's genetically engineered canola. Schmeiser claims that the genetically engineered canola found in his fields grew there due to pollen drift. The lower court has ruled in favor of Monsanto and the case is on appeal.

"I never had anything to do with Monsanto. They were simply trying to see how far they could exercise property rights over farmers, even those who hadn't planted their seed. If I lose my case, every farmer in North America will become a serf."

Percy Schmeiser. "Super Seeds Sweeping Major Markets, and Brazil May be Next." New York Times, 5/16/2000

Following are some of the differences between traditional and the new breed of agriculture:

Traditional Agriculture	Genetic Engineering Agriculture
Developed and innovated to meet community needs and environmental conditions	Developed and innovated to meet global trade and food processing industry requirements
Traditional farmers are close to the commnity	Genetic engineering companies are mostly far from the people
Seed base and varieties ensured by the exchange of seed between farmers and communities	Seed varieties kept under the strict control of seed companies. Seed saving and exchange are strictly prohibited
Community farming and self-sufficiency strengthens community cultural and spiritual identity	Encourages integration into the global economy and into culture of industrial production
Seeks to work in harmony with other species	Competes aggressively with other species
Tends to wide variety use in regions where small and traditional farming is common	Tends to narrow variety base
Uses many crops, which are mutually supportive in needs, and leads to multi-crop harvests. A traditional example: the 3 sisters (corn, beans, and squash)	Uses one crop, against which all other crops are weeds.
Multi-cropping involves plants protecting other plants, and the compatibility of individual protections. Fewer and less chemicals -- if any -- are used.	Requires intensive agrochemical use to combat the pest, weed, fungus, and virus problems arising from monoculture.

Responsibility

Farmers shoulder the risks of genetic contamination. In April 2000, industry successfully lobbied the European Parliament to prevent legislation into the European Union which would clearly make the seed companies directly responsible for any ecological or economic damages resulting from their genetically engineered products. In the same month, the largest farm insurer in Great Britain announced it could not insure farmers for contamination of their non-genetically engineered crops by genetically engineered crops cultivated in neighboring farms. Who protects the farmers then, when they lose their markets?

In the US, small organic farmers in North Dakota decided that they could not plant canola for the 2000 season, because neighboring farmers were planting genetically engineered canola. Because canola is an open-pollinating crop, the organic farmers decided that their organic crop would not escape contamination. In the absence of protection for farmers by companies and the state, the farmers are appealing to neighboring conventional farmers not to plant genetically engineered seed.

Community Nutrition

Genetic engineering in agriculture is receiving huge financial support from governments around the world because of its attractive promise of solutions to agronomic, farming, and food security problems. This represents an important decision-making issue for communities on how problems are to be addressed, and who will provide the solutions.

Currently, there is a tendency among governments and the seed companies to present genetic engineering as a miraculous solution for problems that cannot be solved by laboratory techniques. Seed cannot be genetically engineered to restore fairness to markets that currently squeeze out small farmers with low commodity prices, nor can it be engineered to deal with distribution inequities that contribute to famine and malnutrition. Does it make sense to create, and even support, all the risks to health that genetic engineering creates, when there are other - proven and safer - methods for addressing food security?

Moreover, the over-emphasis on genetic engineering is a problem because resources are being diverted into solutions that set up distant company headquarters as the problem-solvers, rather than the communities or groups that should be empowered to develop solutions for their own people. Rice is currently being genetically engineered to provide higher levels of vitamin A where malnutrition and starvation is high. Critics argue that this approach is a high-risk, techno-fix that is diverting millions of dollars towards a program that does not involve local communities in the process. Moreover, the project has focused on only one of the nutrient deficiencies in communities where famine exists—a lot more than vitamin A is lacking in starving peoples' diets. And it will take considerable money and efforts to educate the local people to grow and eat the rice, which is yellow rather than white. People critical of this scheme note that working with local communities to diversify farming to include the growing of leafy green vegetables meet vitamin A needs and address the wider nutritional problems facing areas of famine.

Some Farmers Organizations that are critical of, or opposed to, genetic engineering and patents on life

- The American Corn Growers Association (US)
- The National Family Farm Coalition (US)
- The National Farmers Union (Canada)
- Coordination Paysanne Europeenne: A European network of farmers organizations
- The Via Campesina: A worldwide network of farmers and peasant movements committed to solidarity, to the well-being of farmers and peasant communities
- The International Federation of Organic Agriculture Movements (IFOAM)

Chapter 7

HUMAN HEALTH AND SAFETY TESTING

Food whose production undermines our communities and our cultural and spiritual beliefs can never be *healthy*. Even if was true, as industry claims, that genetically engineered foods are more nutritious than traditionally bred foods, GE foods would still be unhealthy because genetic engineering may destabilize and undermine community sovereignty over resources, knowledge, and traditions. GE foods could also be considered unhealthy because their production undermines and violates the inherent integrity of living beings, and threatens the very existence of countless other species for the sake of just one species (or, more accurately perhaps, for the sake of profit).

Yet, in addition to the threats and damage to our communities and the earth, there are further risks to the health of our communities posed by the consumption of genetically modified foods. The genetic engineering industry is making bold claims about the nutritional value of their crops. They claim that

- genetically engineered foods are safe
- some genetically engineered foods are better for people, because their nutritional value is higher than non-genetically engineered foods

However, many people are not convinced. A number of critical scientists and some government officials state that the science and the regulations and procedures for understanding the composition of genetically engineered foods are wholly inadequate. They warn that the short and long-term risks of consuming genetically engineered foods are not known. In fact, in many cases these questions are not even being asked.

Food safety is a community- or society-based science. It is the knowledge about which foods are safe for human consumption, the knowledge of how to make toxic foods safe by procedures such as heating, and the knowledge of which foods are particularly healthy and valuable for human health. This knowledge is handed-down experience that is shared and built upon. It is a communal effort involving farmers, community healers, and health experts, among others.

The genetic engineering of plants and animals for food is a brand new experience for our societies and communities. This is for two main reasons:

First, genetic engineering of plants and animals is a **new technology** for the production of food. Although industry supporters say that genetic engineering is a merely a progression in age-old production processes, genetic engineering is breaking many traditional boundaries. It is bringing living beings that are new to our world. Concerned scientists and ecologists warn that **genetic engineering** may transform far more of the organism than is desired. They warn of a whole range of possibly damaging effects that we are not aware of. So the current techniques of genetic engineering may be generally harmful to our health.

In 1999 it was reported by an FBI "mole" that between 1992 and 1995 ADM was ***illegally disposing of "genetic organisms" by adding them to corn gluten animal feed*** *used for international export. According to the alleged report: "The organisms are in liquid form and are* ***sprayed on the corn gluten feed rather than disposed of as required by the Environmental Protection Agency (EPA).*** *The liquid spray also added weight to the feed."*

The Agribusiness Examiner, Issue # 53 October 22, 1999.

Secondly, some genetically modified foods contain **components** from life-forms that have **never been part of human diets**. This means there is no existing community knowledge (traditional or Western scientific) about their effects on humans.

Due to the novelty of these foods and techniques and our lack of experience and knowledge, there is a **high risk factor** for our communities. The risk comes because there is no certainty of safety. Yet many genetically engineered foods have already proved for human and animal consumption. They have been approved by government departments and agencies. How do these officials know they are safe?

You Get What You Ask For
("Hear No Evil, See No Evil, Speak No Evil")

Industrialized countries – the largest base of the genetic engineering industry – have not developed a strong scientific approach to assess the safety of genetically engineered foods. In many cases they have not even introduced strong mandatory regulations to ensure that their weak testing is actually carried out before genetically modified foods are introduced into human and animal foods.

Many industrialized countries (including the US, Canada, and the European Union) adopted the principle of **substantial equivalence** to assess the safety of genetically engineered foods. By

How Safety Testing is (Not) Done in the US. . .

The US is the largest exporter of genetically engineered products, and the country with the m genetically engineered foods approved for human consumption. The chief regulatory body for the approval of genetically modified foods, the ***Food and Drug Administration (FDA)****, made a political decision in 1992 to regard all genetically modified foods as* ***'generally regarded as safe'****. This decision, it now appears, was made in the midst of strong disagreement amongst agency staff, with some scientists claiming that there was a clear need for new assessment procedures to address the novel possible risks of genetically modified foods. In spite of this, the FDA applies the substantial equivalence, but requires* ***no mandatory testing*** *by companies seeking market approval for their products. Instead companies* ***voluntarily*** *submit summaries of their own tests to the FDA.*

The US government has been aggressively pushing a highly-deregulated global environment for the GE industry. US government officials have repeated the claims of the industry that 'this is the most tested food in the world".

A nation-wide movement has started in the US to force the FDA to introduce strict mandatory safety testing, and labeling. Among others, two non-governmental organizations have filed a legal suit against the FDA. The agency's announcement in May 2000 that it will now be compulsory for companies to submit their laboratory data makes no progress or concession to the widening concerns.

this principle: if a genetically engineered crop variety can be proved similar to a non-genetically engineered relative, the genetically engineered variety is safe for consumption. Substantial equivalence testing usually only requires chemical tests of selected components of the genetically engineered plant.

While the application of substantial equivalence varies in the different countries, the basic criticisms of this model are:

- The dynamics of genetic engineering are so different that a simple comparison of the plant's molecular structure with naturally-occurring species is inadequate.
- **Toxicological, biological, and immunological tests** are needed because there is still little understanding about the relationship between genetics, chemical composition, and toxicological risks.
- There is no legal or scientific definition of how big the difference between genetically engineered and conventionally-bred crops should be before the differences place people at risk.
- On one hand, companies argue that these plants are so similar to conventionally bred crops that they do not need special tests or labels. On the other hand, they argue that their crops are so novel that they should get patent rights to protect their inventions. Which are we to believe?
- Not only that, many governments have listened to industry instead of the public, agreeing not to introduce mandatory **labeling** of genetically engineered foods so that at least people could make their own choice.
- According to many concerned scientists, substantial equivalence is completely irrelevant, because it does not ask the questions that we should be asking: what are the risks of genetic engineering? Instead, substantial equivalence starts out with the answer it wants to hear – genetically engineered foods are the same as non-genetically engineered foods – and then proceeds towards that answer.

How Monsanto's Herbicide-Resistant Soy was Safety-Tested

Monsanto's genetically engineered soya – RoundUp Ready Soy (RRS) – is resistant to the company's herbicide RoundUp. RRS is the most widely commerically cultivated and most widely consumed product of genetic engineering in the world. In the 1999 season, RRS accounted for ***more than 50% of the roughly 40 million hectares grown worldwide.***

Clearly, the chemical composition of this soya is different from non-RRS soya, because RRS would not survive the application of RoundUp Herbicide. It would die like conventional soya if herbicide were applied. In addition, it has been accepted knowledge for a decade that RoundUp herbicide changes the chemical composition of soya. In spite of this, the genetic and biochemical differences were considered insignificant. Instead, nutritional qualities were investigated.

Finally, when the tests were performed, no herbicide was applied to the cultivated test RR Soya. The beans tested were therefore not the beans that would be consumed.

Some communities are more exposed to genetically engineered products

It is likely that some communities are exposed to higher quantities of genetically modified foods than others. Awareness and opposition to genetically engineered foods generally grows first in the middle and upper classes of the population in affluent countries, because these groups have more access to information. They then encourage people to avoid genetically modified foods by eating organically grown foods. Non-genetically modified organic foods are currently sometimes 200% more expensive than non-organic food items, which means that less affluent people cannot afford them. As the pressure on the food processing industry to use non-genetically modified ingredients increases, channels for the currently large stocks of genetically modified foods will need to be found. This is likely to be in the lower-end supermarkets usually frequented by less wealthy people, who may not have access to the information they need to protect themselves and their communities. Or the genetically modified produce may be **dumped** as exports to developing countries, were they will be consumed. In 1999, genetically engineered soy intended for export to the European Union was rerouted for domestic use and consumption as a result of the opposition to the foods in the EU. Meanwhile, emergency food aid supplied to the UN World Food Program by the US was partly genetically engineered corn. It is estimated that around 30%, if not more, was genetically modified.

It is therefore important for communities everywhere to protect themselves from genetically modified foods by raising local awareness, and by insisting upon:

- cessation of environmental release of genetically modified organisms
- segregation of already marketed products, and
- labeling of already marketed products

GENETIC ENGINEERING AND GLOBALIZATION

Agricultural genetic engineering has generated an almost simultaneous worldwide revolution. Field trials began to spread around the globe in the early 1990s, and commercial cultivation began in the mid 90s. After just 4 years, 50% of the soybean crop, 33% of corn and 55% of the cotton crop in the US was genetically modified. Meanwhile, 62% of canola cultivated in Canada and 90% of soy grown in Argentina is genetically modified. It is estimated that the percentage of genetically modified crops grown worldwide increased 44% from the 1998 to the 1999 growing seasons. Moreover, the genetically modified seeds of just one company – Monsanto - account for more than half of the 40 million hectares of genetically modified crops.

Why So Fast?

The exponential spread of genetic engineering into agricultural systems worldwide has been facilitated by the parallel process of **economic globalization**. Proponents of economic globalization describe it as the creation of "global economic interdependence" - the systematic interweaving of economies, technologically, educationally, ideologically, and culturally - to ensure global peace and to extend the reach of prosperity and progress attained in the industrialized countries to so-called developing countries. In reality, however, the economic globalization process has centered around the transformation of the world into a global market place, governed by transnational corporations and structured by trade regimes that have gained precedence over other concerns.

Economic globalization has further meant:

- deregulation and liberalization of industry and production, often lowering ecological or social standards to make room for cheaper production and higher profits for shareholders and company executives, and externalizing the costs of cutting corners on workers, community health, and the environment;
- the construction of a global political structure and of a vision of a new world order pivoting principally on market values. In this context, cultural, spiritual, ethical, social, and ecological values central to local communities are treated as **discriminatory barriers to trade;**
- the creation of giant transnational corporations with no connection to the peoples, culture, resources, or environment in the places where they operate, unless such a connection somehow increases profitability;
- new possibilities for the exploitation of nature and of people in a planet now primarily defined and viewed as one big marketplace;
- the creation of international governing bodies to oversee and enforce the implementation of pro-free market legislation by governments worldwide.

The Players

Institutionally, the **World Trade Organization** (WTO) serves as the functional center of the economic globalization process. The WTO was formed in 1995, to take over the role played by the General Agreement on Trade and Tariffs (GATT). It was the last round of the GATT, the Uruguay Round, which brought agriculture more systematically into the globalization process. The Uruguay Round also introduced, through strong industry lobbying, the framework and pressure for a global regime for the patenting of life forms. International financial institutions such as the **World Bank,** the **International Monetary Fund** and some institutions within the **United Nations**, also actively advocate economic globalization. **Regional trade regimes** such as **NAFTA** and the **European Union** are also advancing economic globalization within the territories where they apply.

For indigenous peoples, economic globalization is no new phenomenon—it's just the most recent form of centuries-old waves of colonialism whose aim has been the theft of their lands and extraction and exploitation of their resources. The "new global economy" is just another colonial force to contend with, in addition to the colonial nation states.

The Global Spread of GE Agriculture

With economic globalization as its global delivery system, genetic engineering technology has developed into a new form of colonization - at the molecular level - that has been called biocolonialism. Large transnational agrichemical/seed companies have used increasing market "openness" to build global empires by buying up seed companies in many countries. In this way they acquire global infrastructure to introduce their seed into many countries around the world. Thus across the world communities are simultaneously seeking to prevent bioprospecting and the release into the environment of the genetically modified crops. Such efforts have formed in Chiapas (Mexico), Ecuador, the Philippines, India, Europe, and elsewhere around the world.

At the same time, global governance structures, their accompanying legislation, and their regulatory regimes have been used as mechanisms to ensure that the floodgates remain open. In particular, the countries with the most developed agri-genetic engineering business and the greatest exporters of genetically engineered products (the USA, Canada, and to a lesser degree, the European Union) have used free-trade structures such as the World Trade Organization to force the introduction and import of agri-genetic engineering in other countries.

- The **US** has suggested it will take the European Union to the **WTO Dispute Panel**, to force the EU to lift the ban it has placed on the import for consumption or the cultivation of certain US exports of genetically engineered seed and commodities
- The **US** threatened to pull out of a trade pact if the government of **Aotearoa/ New Zealand** required labeling of food products containing genetically modified organisms
- The **US** has tried to use a WTO-appointed body, the **Codex Alimentarius**, to prevent labeling of genetically modified food globally
- The **European Commission**, the unelected executive power of the European

Union, has threatened **Austria** and **France** with punitive action for the bans these countries have placed on genetically modified corn

- The US has threatened countries such as **India, Denmark, and Thailand** with punitive action if they do not allow for patents on life in their legislation
- **Argentina, Australia, Canada, the US, and more** (the so-called "Miami Group") have for years tried to prevent the creation of an international BioSafety Protocol that would obligate GMO-exporting countries to declare and label exports of genetically modified organisms, and to bear liability for any environmental or public health damages to the importing countries.

Increasing awareness of economic globalization and its impacts has fostered grassroots resistance movements in many places, however. And local actions taken worldwide to reject genetic engineering have been extremely successful. Cities in France have established Genetic Engineering Free Zones in their facilities (such as school cafeterias). Private people in support of field trial destruction declared "1000 GE-Free Zones" in the country of Norwich, England. The Brazilian Landless Movement declared a moratorium on planting genetically engineered seed in newly acquired lands. Developing countries have taken a strong stance in the Biosafety Protocol negotiations. These assertions of peoples' wills for their land to be free of genetic engineering has already had a significant impact on the industry's aim to go global with its genetically engineered seed. In 1999, a 20% drop in US soy imported by the European Union was created by European consumers' rejection of GE foods. The European Union obtained non-GE soy from other soy producing countries such as Brazil.

WHAT CAN YOU DO?

Genetic research is a given. It will continue. The potential problems are also a given. We must address them. This does not mean that we must just come to terms with the problems, and be prepared for the worst case scenario. Rather, the challenge we face is to protect ourselves, our families, and our lands as much as we can. There are many things that individuals and indigenous peoples can do to this end. There are many things that indigenous people specifically, because of our world view and because of our unique political situations, can and must do.

We must both **protect** and **promote** biodiversity, particularly within our own territories. We can protect biodiversity by protecting against biopiracy— by preventing appropriation of genetic resources from our territories. We can also protect biodiversity by maintaining the environmental integrity of our ecosystems. To do this, we can work to prevent or clean up pollution, eliminate or reduce pesticide use, prevent or reverse monocropping on a large scale to prevent further loss of traditional medicinal and food plants and animals.

There is also evidence that more suitable means of raising stock are in order. In many ways, extensive cattle herds, particularly when overgrazed, are essentially the same as monocropping. In many parts of the country, cattle have replace buffalo and other species, and the pressures on the land are beginning to show. Whereas once many species inhabited the land, and buffalo were a major contributor to the life cycles on the plains, now rangeland is dominated by cattle, a species foreign to the natural ecosystems of this continent.

We can promote biodiversity by promoting more traditional agricultural practices, like multi-cropping instead of monocropping, and saving and trading seeds. We can eat more foods than are currently part of the mainstream diet in the US. Diverse, clean foods can be grown or gathered from nature at home, so the problem of high cost organic alternatives in the supermarkets can be alleviated.

OK, So What Can I Do?

When considering what you can do, it may help to start closest to home: What can you do to protect you and your family? The first step is education. Already, by reading this briefing, you have become more educated. You can share some of this information with friends and family. You can find more information if you are interested. This briefing has several good references to start.

From there, you might try to eat cleaner foods when possible. Individuals concerned about genetically engineered foods can avoid highly processed and mass marketed foods, since these are more likely to contain genetically modified ingredients. Buying such foods encourages marketing, and increases the profits of the corporations that promote genetically engineered foods. As an alternative, whenever possible people can buy locally produced foods, encourage local farming and seed-saving/exchange to promote diversity of local crops, and even promote revival of a more traditional diet.

You can also reach beyond yourself and your family, and talk to other people about these issues, and work on solutions together. At the community level, all of the impacts are that much greater. And if changes are made at the tribal level and beyond, the impacts are even greater still.

There are a lot of actions that tribes can take to protect themselves and their members. Tribes can regulate research on reservations, thereby preventing appropriation of biodiversity. Environmental and zoning regulations can help stop introduction of genetically engineered species within the tribal territory. A sample piece of tribal legislation, designed to prevent unwanted research and prevent introduction of genetically engineered species is available on IPCB's website: www.ipcb.org/pub/irpaintro.html.

To augment this approach, tribes can also offer education about the issues of genetically engineered organisms to landowners and lessees in the area surrounding the tribal jurisdiction, in order to help prevent migration of genetic "pollution" onto tribal land.

Tribes can also commit to train local community members who can take responsibility for review, oversight, and recommendations concerning research proposals to the governing authority. Tribes should not have to bear the financial burden of training and technical assistance alone, especially when the research is initiated by outside interests.

Education of tribal community members should be a priority for Indigenous people concerned about biocolonialism, because until community members are aware of the issues, they are vulnerable to abuses from unethical research practices, and to other dangers from genetic engineering of which they may be unaware. Community education can be accomplished by organizing forums and workshops on the topics of genetic research, genetic engineering, and biocolonialism. Anyone who has read this briefing already knows enough to start sharing their knowledge in a way that will help others. Community radio programming is also an excellent outreach tool. IPCB and other interested organizations can make available resource persons and educational materials to support such forums.

The topic of biocolonialism should also become a regular topic of discussion on the agendas of on-going regional conferences, because it impacts so many important areas of Indigenous peoples' lives, such as health, education, the environment, cultural resources, natural resources, and general sovereignty concerns.

Individuals concerned about the idea of allowing patents on life forms can take individual action by joining existing campaigns (like the No Patents on Life campaign headed by the Council for Responsible Genetics) and by encouraging local actions. Possible local actions include tribal resolutions declaring tribal land and resources to be patent-free zones, where no patents on life forms will be allowed. Another potential local action is for tribes themselves to take actions, on federal and international levels, declaring the entire tribe's opposition to the concept of patenting life forms.

CLOSING

We hope that this briefing has helped you understand more about what is going on in the genetics engineering industry. We will consider it a success if you feel more informed, and if it leads to you making decisions based on information we have provided or that we have helped you find. We hope that we have provided enough material to allow those who are interested to begin to address biocolonialism in their own communities. We encourage you to talk about these issues. We will all be effected by how we as indigenous peoples decide to deal with the issues. Talking about them is the first step towards protecting ourselves, our families, and our environment from abuses and towards ensuring that the wisdom of our ancestors is brought to bear on something that is sure to impact our future.

Glossary

antibiotic: a substance that is antagonistic to living organisms; generally used to refer to substances that kill or prevent growth of bacteria and occasion*ally viruses.*

biocolonialism: an extension of colonialism into life processes, and agricultural systems.

biodiversity: the quantity and variety of living organisms in a specific area and time. This can be used to refer to genes, species, ecosystems, and cultural diversity.

Bt: *bacillus thuringiensis*, a bacterium traditionally sprayed on plants by organic farmers for pest control, specific genes of which are now being engineered into plants themselves.

cell: the basic structural unit that makes up all living organisms.

center of diversity/ center of origin: the location/area where a species is said to originate. Typically there are many related varieties living in the area.

chromosome: structures found inside the nucleus of a cell that are made up of DNA and protein, and contain the cell's genetic information.

clone: an identical copy of an individual or a gene, or the totality of all the identical copies made from an individual or a gene. In genetics, the clone is identical in genetic make-up to the original.

cloning: the practice of artificially producing two or more genetically identical organisms from the cells of another organism.

deoxyribonucleic acid (DNA): a polymer of nucleotides that serves as genetic information. When combined with histone protein and tightly coiled, it is known as a chromosome.

gene: a unit of inheritance that, in the classic sense, occupies a specific site (locus) within the chromosome.

genetic engineering: procedures that allow for the alteration of genetic material. Includes copying and multiplying genes, recombining genes or DNA from different species, and transferring genes from one species to another, bypassing the reproductive process.

genetics: the science of heredity. The study of genes, how genes produce characteristics and how the characteristics are inherited.

genome: the total genetic makeup of an individual or organism. A set of all the genes of an organism.

genomics: the study of all the genes of a given specAies and the way in which they interact in order to generate the characteristics of that species.

germ cell: a reproductive cell, such as sperm and egg cells.

germplasm: the reproductive parts of plants and animals.

herbicide: a chemical used to kill plants, usually species other than a crop intended to be grown.

monoculture: when one crop is grown exclusively.

nucleus: the membrane-bounded structure found in a cell which contains the genetic material.

organism: any living thing

reductionism: the philosophical belief that phenomena or organisms are best understood by breaking them up into smaller parts. For instance, an organism is to be completely understood by its genes, a society in terms of its individuals, and so on.

transgenic organism: an organism created by genetic engineering in which one or more foreign genes from other species have been incorporated into its genome.

transnational corporation: a large business enterprise with centers of operation in several nations.

Sources

Concepts in Biology, Enger, E. D., et al., 1988; A Dictionary of Genetics, King, R. C., and Stanfield, W. D., 1997; Genetic Engineering: Dream or Nightmare?, Dr. Ho, Mae-Wan, Gateway Books, UK 1998; Exploding the Gene Myth, Hubbard, Ruth and Wald, Elijah, Beacon Press 1999; Genetic Engineering: Dreams and Nightmares, Russo, Enzo and Cove, David, W.H. Freeman & Co., 1995.

RESOURCES

Suggested Further Introductory Reading

Genetically Engineered Food: Changing the Nature of Nature. What you need to Know to Protect Yourself, Your Family and Our Planet. Martin Teitel and Kimberly Wilson. Foreword by Ralph Nader. Parker Street Press, 1999.

Genetic Engineering - Dream or Nightmare? The Brave New World of Bad Science and Big Business. Dr. Mae Wan Ho. Gateway Books, UK, 1998.

Genetic Engineering, Food and Our Environment, Luke Anderson. Chelsea Green Publishing Company, Vermont, 1999, 1-890132-55-1.

Centers of Diversity. Global Heritage of Crop Varieties Threatened by Genetic Pollution. Greenpeace International, 2000.

Biopiracy and Intellectual Property Rights

Biopiracy: The Plunder of Nature and Knowledge, Shiva, Vandana. South End Press, Boston, MA, 1997, 0-89608-555-4.

Protecting What's Ours: Indigenous Peoples and Biodiversity, Edited by Rothschild, David, South and Meso American Indian Rights Center, Oakland, CA, 1997, 0-9635396-0-4

Intellectual Property Rights for Indigenous Peoples: A Source Book, Greaves, Tom. Society for Applied Anthropology, Oklahoma City, OK, 1994, 0-9642023-0-1.

Stolen Harvest. The Hi-Jacking of the Global Food Supply, Shiva, Vandana. South End Press, 2000, 089608-607-0.

Farm Animal Genetic Engineering. A report by Dr. Tim O'Brien for Compassion in World Farming Trust. Second Edition, Revised. December, 1998. Available at: www.ciwf.co.uk

Publications

GeneWatch. Council for Responsible Genetics magazine (to subscribe, contact address below).
RAFI Communique. Rural Advancement Foundation International briefings (to subscribe, contact address below).

Biotechnology and Development Monitor. University of Amsterdam. Free subscription available from: University of Amsterdam, Department of Political Science, Oudezijds Achtervorburgwal 237, 1012 DL Amsterdam. The Netherlands. Email: monitor@pscw.uva.nl or download issues from their website: www.pscw.uva.nl/monitor

Seedling. Magazine produced by GRAIN**.** Order free subscription at address below or download issues from their website: www.grain.org

Good Web Resources

www.biotech-info.net.
Major focus on genetic engineering in agriculture with the most up-to-date and useful political and lay scientific and expert analysis.

www.sustain.org/biotech
Large database with wide range of information sources on genetic engineering in agriculture and intellectual property and biopiracy issues.

Organizations

There are numerous organizations working on issues related to genetic engineering and biocolonialism. Here we list only a few of those organizations that are currently able to provide quality resource materials and advocacy support for the public.

Council for Responsible Genetics
5 Upland Road, Suite 3
Cambridge, MA 02140
Tel: (617) 868-0870
E-mail: crg@genewatch.org
Website: www.gene-watch.org

Food First/Institute for Food and Development Policy
398 60th Street
Oakland, CA 94608
Tel: (510) 654-4400
Website: www.foodfirst.org

Genetic Resources Action International (GRAIN)
Girona 25, pral., E-08010
Barcelona, Spain
Tel: (34-93) 301 13 81
E-mail: grain@bcn.servicom.es
Website: www.grain.org

Indigenous Peoples Council on Biocolonialism
P.O. Box 818
Wadsworth, Nevada 89442
Tel: (775) 835-6932
Website: www.ipcb.org

Institute for Agriculture and Trade Policy (IATP)
2105 First Avenue South
Minneapolis, MN 55404
Tel: (612) 870-3410
E-mail: iatp@iatp.org
Website: www.iatp.org

Institute of Science in Society (ISIS)
Dr. Mae Wan-Ho, Director
24 Old Gloucester St.
London, WC1N 3A1, UK
Website: www.i-sis.org

International Center for Technology Assessment (ICTA)/Center for Food Safety
660 Pennsylvania Ave. SE, Suite 302
Washington, DC 20003
Tel: (202) 547-9359
Websites: www.centerforfoodsafety.org & www.icta.org

Native Seed/Search
526 N. 4th Avenue
Tucson, AZ 85705
Tel: (520) 622-5561

Organic Consumers Association
6101 Cliff Estate Road
Little Marais, MN 55614
Tel: (218) 226-4164
Website: www.purefood.org

Pesticide Action Network North America (PANNA)
49 Powell St. Suite 500
San Francisco California 94102
Tel: (415) 981-6205.
E-mail: panna@panna.org
Website: www.panna.org

Rural Advancement Foundation International (RAFI)
110 Osborne St., Suite 202
Winnipeg MB R3L 1Y5, Canada
Tel: (204) 453-5259
E-mail: rafi@rafi.org
Website: www.rafi.org

San Juan Agriculture Co-op
P.O. Box 1188
San Juan Pueblo, NM 87566
Tel: (505) 747-3146, 1-888-511-1120
E-mail: puebloharv@aol.com
Website: www.puebloharvest.com

Santa Ana Blue Corn Project
The Cooking Post
Tel: 1-888-867-5198
Website: www.cookingpost.com

Third World Network
228 Macalister Road
10400 Penang, Malaysia
Fax: 604-2264 505
E-mail: twn@igc.apc.org
Website: www.twnside.org.sg

Traditional Native American Farmers Association
P.O. Box 170
Tesuque, NM 87574
Tel: (505) 983 2172

Union of Concerned Scientists
(National Headquarters)
2 Brattle Square
Cambridge, MA 02238-9105
Tel: (617) 547-5552.
E-mail: ucs@ucsusa.org
Website: www.ucsusa.org

Via Campesina
Apdo Postal 3628
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Tel: 504 20 1218
E-mail: viacam@gbtm.hn or via@sdnhon.org.hn
Website: www.sdnhon.org.hn/miembros/via/