2005

The Moral Dilemma of Genetically Modified Foods (GMOs)

Anamarie Beluch

THE MORAL DILEMMA OF GENETICALLY MODIFIED FOODS (GMOS)

BY ANAMARIE BELUCH

Genetically modified (GM) foods are foods that are produced from genetically modified organisms (GMO) that have had their DNA altered through genetic engineering. The process of producing a GMO used for genetically modified foods involve taking DNA from one organism, modifying it in a laboratory, and then inserting it into the target organism's genome to produce new and useful genotypes or phenotypes. These techniques are generally known as recombinant DNA technology. In recombinant DNA technology, DNA molecules from different sources are combined *in vitro* into one molecule to create a new gene. This DNA is then transferred into an organism and causes the expression of modified or novel traits. Such GMOs are generally referred to as transgenic, which means pertaining to or containing a gene or genes from another species. There are other methods of producing a GMO, which include increasing or decreasing the number of copies of a gene already present in the target organism, silencing or removing a particular gene, or modifying the position of a gene within the genome.

Genetically modified foods were first placed on the market in the early 1990s. The most common modified foods are derived from plants: soybean, corn, canola, and cotton seed oil. Currently there are many varieties of GM foods that exist. GM soybeans, for instance, are resistant to herbicides by inserting herbicide resistant genes taken from bacteria. On the other hand, GM corn is resistant to certain pesticides, by adding a new gene into the genome. This allows farmers to use vast amounts of pesticides, which would normally kill the plant. GM tomatoes are resistant to rotting. This was first done by making tomatoes resistant to antibiotics, but because of concern from the healthcare community, tomatoes are now modified in alternative ways. GM cotton is pest resistant, which is done by adding a new gene into the plant genome. GM Rapeseed plants and sugar cane plants are resistant to certain pesticides and can tolerate increased amounts of crop spraying. This is also done by inserting a new and foreign gene into

the plant genome. An insect killing gene, Bacillus thuringiensis, is added to GM sweet corn. This allows the plant to produce its own insecticide, which in turn reduces insect attacks. Three foreign genes are added into GM rice's genome, two genes are from daffodils and one is from a bacterium. This modification genetically alters rice to contain high amounts of vitamin A (beta carotene).

The first commercially grown genetically modified whole food crop was the *Flavr Savr* tomato, which was made more resistant to rotting by Californian company *Calgene*. The company *Calgene* was allowed to release the tomatoes into the market in 1994 without any labeling indicating to the consumer that it was a GM food. Consumers loved the product and purchased the tomatoes at two to five times the price of regular tomatoes. Overtime, production problems occurred and competition arose from a conventionally bred, longer shelf-life variety, which prevented the product from becoming profitable. A variant of the *Flavr Savr* was used by *Zeneca* to produce tomato paste, which was sold in Europe during the summer of 1996. The product's labeling and pricing were used as a marketing experiment, which proved, at the time, that European consumers would accept genetically engineered foods.

This seemingly accepting attitude of GM foods radically soon changed, after outbreaks of Mad Cow Disease occurred. This weakened consumer trust in government regulators, and protesters began rallying against the introduction of Monsanto's "Roundup-Ready" soybeans, one of the first GM foods introduced to the consumer. This company's own herbicide was worried by some to cause a monopoly. The next GM crops included insect-protected cotton and herbicide-tolerant soybeans, both of which were commercially released in 1996. Since then, GM crops have been widely adopted in the United States. They have also been extensively planted in

several other countries (Argentina, Brazil, South Africa, India, and China) where the agriculture is a major part of the total economy.

Even with the wide use of GM foods, the European nation has taken a strongly negative attitude toward GMOs. Following the February 1999 controversy surrounding genetically modified potatoes being toxic to laboratory rats, the European anti-GM food campaign arose. It produced a moratorium on the growth and import of crops in Europe, which led to trade disputes with the US. Genetically modified crops are today very rare in Europe. There are strict labeling laws and regulations on GM foods, and most public opinion is extremely negative regarding GMOs. The European governments regard the economic benefits of this technology to be small, and even some African nations have opposed GM crops, even to the point of rejecting food aid. In April 2004, there was a total ban on genetically modified seeds in Venezuela, and in January 2005, there was a ban on importing and planting genetically modified maize in Hungry. Then in August of 2006, American rice exports to Europe were found to be contaminated with unapproved engineered genes. The United States government has since declared the rice "safe for human consumption," a label you would assume to find on an experimental chemical of some kind. There has been much less concern about genetically modified foods in the United States, probably because there is no labeling required for it, and thus, most Americans do not realize they are consuming GMO's. The controversies surrounding GM foods and crops commonly focus on human and environmental safety, labeling and consumer choice, intellectual property rights, ethics, food security, poverty reduction, and environmental conservation.

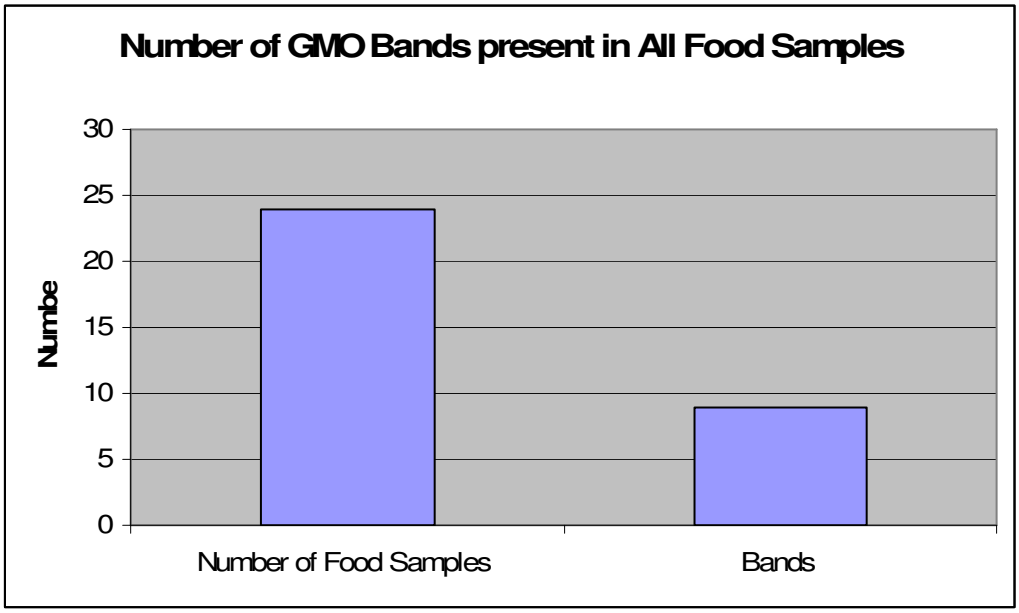
Along with the increased use of GMOs comes increasing fears of the effects of GMOs on humans and the environment. By far the most common genetically modified organisms are crop

plants, but the technology has now been applied to almost all forms of life and that is where the fear lies. The technology has caused pets to glow under UV light, bacteria forming a HIV-blocking living condom in humans, pigs bearing spinach genes in order to produce low fat bacon, mice that produce healthy fish oils, quick maturing salmon and goats that produce spider silk in their milk. Critics fear that even GM crops pose a serious risk. GM foods or what they call "Frankenstein foods," could have unseen adverse health effects on human consumers. These fears include GMOs producing toxic proteins and transferring antibiotic resistance. Another threat is that modified crops could become insidious superweeds. The insect repelling properties of GM plants are thought to speed the evolution of insecticide-resistant pests, causing the accelerated evolution of "super pests." GM crops are also feared to be accidentally bred with wild plants, which would genetically pollute the environment. This could cause serious problems in regards to crops engineered to produce pharmaceutical drugs because they can become cross breed with food crops.

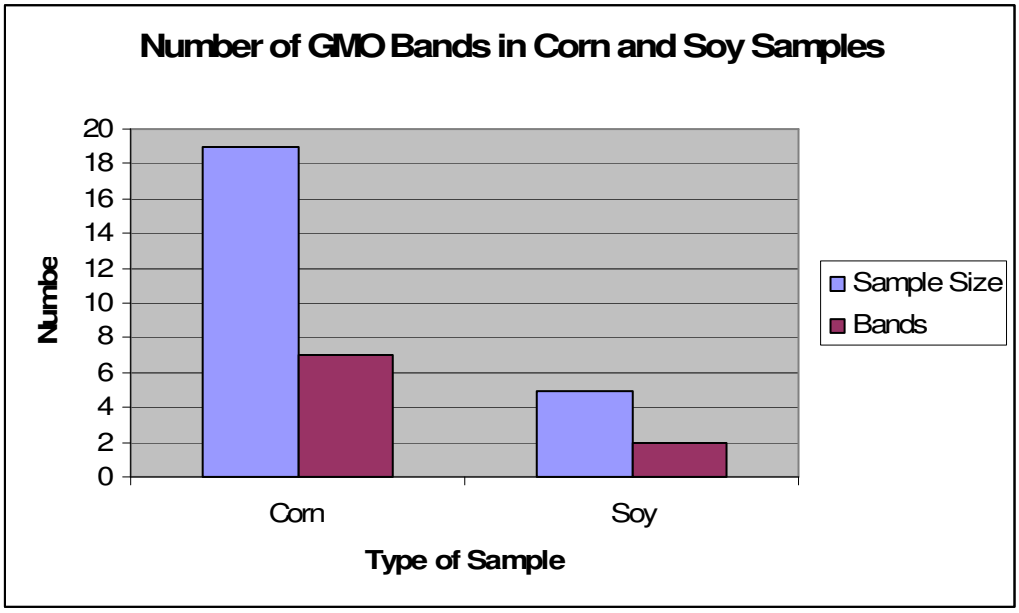
Although some may think that accidental crossbreeding or contamination does not occur, studies have shown that it happens easier than one may think. The UK government conducted large numbers of field trials, which revealed that gene transfer does occur. In 2002 a study confirmed that transgenic genes had spread from the United States to traditionally grown maize crops in Mexico. A 2004 study demonstrated that there was vast contamination of conventional varieties of US food crops. Another study revealed that pollen from GM plants can be carried by the wind for up to ten kilometers, which can cause contamination of other crops. The percent of GM crops that occupy agriculture in the Unites States and globally, compared to its conventional counterpart is unknown. If the percentages of GM crops are unknown, it would make it difficult

to keep track of GM crops, thus making the chance for cross contamination between GM crops and non-GM crops extremely high.

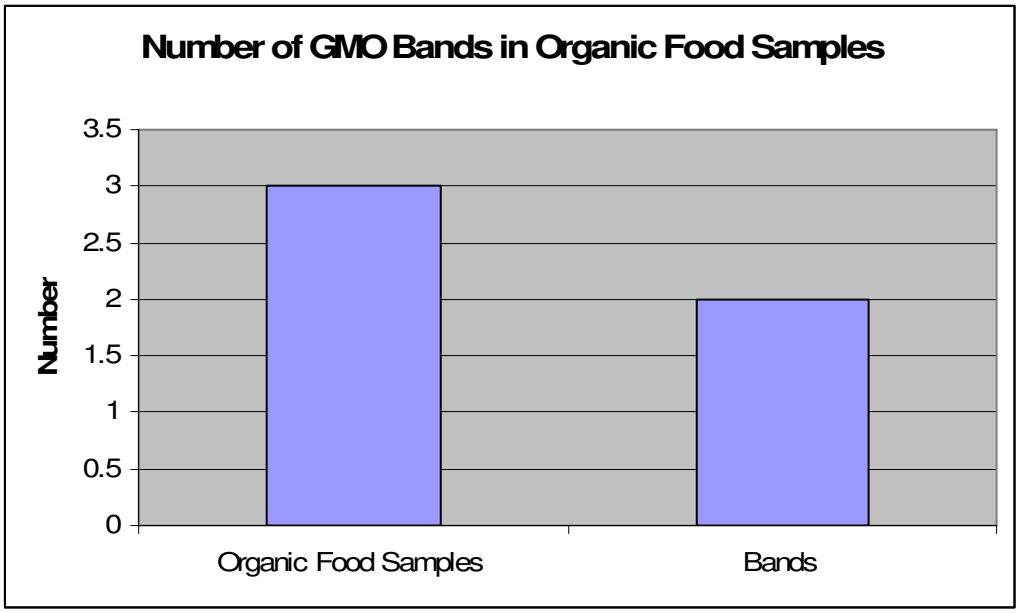
My fellow ecology classmates and I wondered how much of the food in the United States contained GMOs. We pondered this because in the United States it is not mandatory for the government to label or specify if products contain GMO's because according to the FDA they are considered not toxic or harmful, making the average consumer unaware of GM foods in their diet. We performed an experiment last semester regarding this topic. We examined conventional foods and organic foods on the market. Among the scientific world there is a rough hypothesis that 80% of conventional corn is genetically modified, 60% of conventional soy is genetically modified, and 15% of organic corn and soy is genetically modified. While this long standing hypothesis exists in the United States, none of the products are labeled as such. So, we examined the hypotheses and tested corn and soy foodstuff products, including organic products and conventional products, such as Fritos. Through the PCR method, we identified GMO's in our food samples, and used the chi square test and p-values to come to conclusions about our products, based on the original hypotheses. We determined that our samples did indeed contain GMOs.



Through our experiment we found that 30% of our corn samples contained GMOs and 40% of our soy samples contained GMOs.



Even though our results were lower than expected, it was still surprising that the products clearly contained GMOs and were not labeled as such. What we were most surprised to find was that 66% of our organic samples contained GMOs.



This was extremely unexpected because these products actually had labels that claimed the product contained "non GMOs." We concluded that cross contamination between non-GMO food products and GMO food products is evident and can occur quite easily. A couple reasons for cross-contamination could come from not clearly knowing which crops are GM crops and which are not, from transporting crops to the processing plant (because all crops are usually carried in the same trucks), or during the processing of the crop for commercial use.

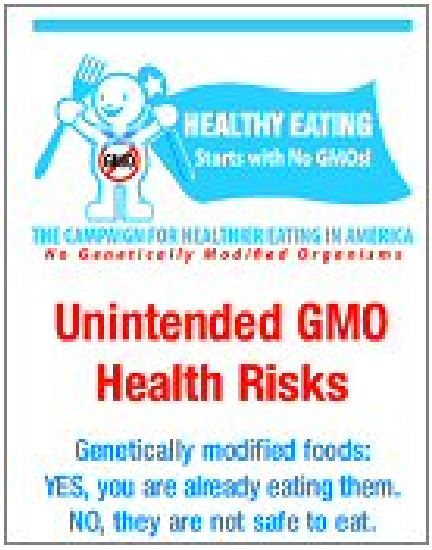
Even though there is controversy regarding GM foods, between 1995 and 2005, the total surface area of land cultivated with GMOs had increased by a factor of 50, from 4.2 million acres to 222 million acres, of which 55 percent occurred Brazil. There has also been rapid expansion of GM cotton varieties in India since 2002. In India, the publicity given to the most

popularly used transgenic trait, the Bt insect resistance gene, has encouraged the further adoption of better performing hybrid cotton varieties, mainly because the Bt trait has substantially reduced losses to insect predation. There has also been extensive documentation of economic and environmental benefits of GM cotton in India to the individual farmer, which also helps to encourage the use of GMOs.

It was estimated that in 2003, countries that grew 99 percent of the global GM crops were the United States (63 percent), Argentina (21 percent), Canada (6 percent), Brazil (4 percent), China (4 percent), and South Africa (1 percent). The Grocery Manufacturers of America then estimated that 75 percent of all processed foods in the United States contained a GM ingredient. Then it was estimated in 2006 in the US that 89% of the planted area of soybeans, 83 percent of cotton, and 61 percent corn was of genetically modified varieties. Even with this increase of GM crops, there have been several opposing studies done that found genetically modified varieties of plants do not produce higher yields than normal plants.

In the book "Seeds of Deception," the author Jeffery M. Smith exposes industry and government lies regarding the safety of genetically modified foods.

This is a logo that the author promotes and sells on his website.



The author divides the book into nine chapters, creating a clear roadmap proving that GM foods we eat are unhealthy. In the first chapter, the author explains lessons that we have learned from overseas, regarding GMOs. Smith tells the story of Arpad Pusztai, a scientist, who went public about GM potatoes severely damaging the immune system and organs of rats. As a result of his findings Pusztai was suspended from the Scottish Research Institute, where he worked for thirty-five years, and was silenced with lawsuits. His finding remains the only independent safety assessment in a peer-reviewed journal, while all others are performed by the GM food industry.

In his next chapter he explains some of the possible ways GM foods could present problems. He claims the genetic engineers continually encounter unintended side effects from the GMOs. Some of which include the plants creating toxins, the plants reacting to weather differently, they contain too much or too little nutrients, the plants become diseased or malfunction and die. He then explains twenty-one ways in which the process of genetic engineering could create serious health problems. Some or which are through code scrambling, chaperones and hitchhikers in DNA, messing up the host normal DNA, horizontal gene transfer

and antibiotic resistance, position effects, unknown environmental influences, gene silencing, turning on and off genes randomly, hot spots in the genome, waking sleeping viruses, causing cancer, unknown risks from breathing GM DNA, and unknowns in new host DNA – genetic disposition, synthetic genes, complex unpredictable interactions, rearranged codes, gene stacking, nutritional problems, allergens, and human error.

In the third chapter, the author described how in 1998 six Canadian government scientists tried to stand up to pressure to approve Monsanto's genetically engineered bovine hormone (rbGH), which they considered unsafe. He explains how the scientists were threatened by senior government officials, how files were stolen, how Monsanto offered to bribe them, and how one senior official suddenly quit and disappeared. This was similar to what happened in the US in the 1980s, when FDA scientists tried to oppose GMOs and were stripped of responsibilities or fired for doing so. The FDA eventually approved rbGH, based on research submitted by Monsanto, which distorted or deleted data about serious health effects, including cancer.

In the next chapter he explains how GMOs can cause a deadly epidemic. He describes how in 1989, first dozens and then thousands became ill, and finally how one hundred people died, and how others struggled with paralysis, excruciating pain, and ongoing debilitating symptoms. The cause was from contaminants produced by one company's genetically modified variety of a food supplement, L-tryptophan. He explains how the FDA tried to divert the blame and how current regulations are extremely loose and would allow for the same type of situation to happen today.

The next chapter he titles, "Government by the Industry, for the Industry." He quotes from Henry Miller, who was in charge of biotechnology issues at the FDA from 1979 to 1994,

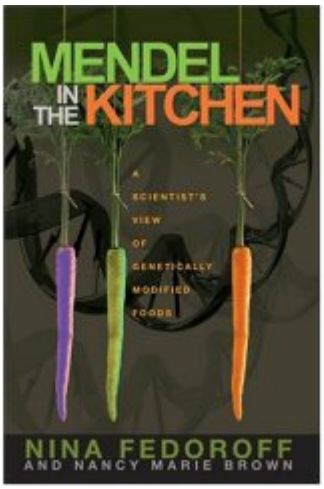
"the U.S. government agencies have done exactly what big agribusiness has asked them to do and told them to do." Smith goes on to say how the GM food industry's influence has dictated by policy, and how the FDA ignored the recommendations by their own scientists, and approved GM foods without requiring safety tests.

Smith explains how allergies are a large concern in the GM food industry. He explains how an infant girl in England broke out in cold sores from drinking soymilk, but was tested as "not allergic" to normal soy. This meant that she was allergic to something in the GM soy milk that was not present in the natural soy milk. It could be the increased amounts of the allergen, trypsin inhibitor. This could explain why allergies to soy have increased by 50%, since the Roundup Ready soy was introduced by Monsanto. Although, it has been confirmed that allergies can be transferred into food via genetic engineering, no allergy test are done or required on GM foods. He explains how this only came to the public's attention after StarLink corn had been blamed for severe and deadly allergic reactions. The FDA took one year do develop tests, but the test were unreliable and the EPA rejected the results. There is new evidence that suggests other varieties of corn are allergenic as well.

He further goes on to explain how the media is used to mold the public's opinion about genetically modified foods. According to Smith, the biotech industry uses its considerable resources to promote a one-sided image of GM foods as safe and necessary, and stifle coverage about health and environmental damage that GM foods can cause. He describes how a Fox TV station canceled a series about GMOs, a publisher canceled a book contract about GM foods, and a scientific journal refused papers about GMOs, all due to fear of lawsuits by Monsanto. He also

presents the story about Ignacio Chapela, who wanted to publish incriminating evidence about GMO contamination, but was threatened by the Mexican government.

Smith concluded with how even animals have a keen sense and avoid GMOs. He explains how mice avoid eating GM foods, as do rats, cows, pigs, geese, elk, squirrels, and others. Scientists discovered that animals refuse to eat the same GM foods that we consume everyday. He then explains how humans can change their diet and way we can avoid eating GMO's on a daily basis.



In the book "Mendel in the Kitchen," by Nina Fedoroff and Nancy Marie Brown, they explain how the genetically modified foods of today are no different then the foods we've been eating for millennia. The book explains in great detail how farmers have been genetically altering crops since the beginning of agriculture. The authors describe how a millennium before genetically engineering crops, farmers succeeded in transferring genes from cold tolerant and drought resistant weeds to wheat. They did this by changing the environment and conditions in which the plant grew. This allowed mutant plants with ordinarily lethal genetic changes to not only survive, but expand their range. Fedoroff and Brown argue that this was the first genetically modified crop.

The authors then explain how farming began 10,000 to 50,000 years ago, and was forced to change with the increasing population because cities, kingdoms, and empires were built on the growing of grains. They explain the early beginnings of genetic altering. In 1857, the invention of nitrogen added to the soil as fertilizer, allowed for the increase in crop yield. This was the premise for crop rotation. In 1859, Darwin published the "Origin of Species," which began scientific debate that would last until the 1930s. His theory sparked Luther Burbank to experiment with potatoes. Potatoes are most often clones because they reproduce through tuber sprouts and are genetically identical to their parent. Burbank found that sometimes a potato plant produces a fertile seed. He planted it and began selecting only certain offspring, and then he selected again. This produced a new variety of potato. The art of grafting, which places foreign

bark in a tree, producing a new variety of tree, was also viewed as unnatural and interfering with God's plan.

In the chapter, Tinkering with Evolution, Federoff and Brown, defend Calgene's Flavr Savr Tomato. They explain how the tomato's resistance to rotting was good because it allowed the tomato to gain shelf life and made the tomato able to ship more easily. They explain that the only reason the Flavr Savr tomato was taken off the market, was because they were not profiting enough to continue to produce them. The authors also defend the experiment that was done in 1990 by the DNA Plant Technology Corporation. The experiment consisted of inserting a fish gene into a tomato. They explain how the tomato never made it into the market, although the gene worked properly. The gene produced the same protein, in the tomato as it did in the fish, which would protect the tomato from cold damage. The authors also defend antifreeze proteins being used from fish in wheat and other crops.

Federoff and Brown, also agree with and defend Francois Jacob, a molecular geneticist in 1977, who raised the question, "what makes a butterfly different from a lion." He believed that a scientific engineer started with a plan, the materials specified, and then designs the product that completes the job intended, even if it's far from perfect. He believed that all life forms were a single cell at one point and through genetic manipulations and evolution, formed what they are today. He uses the example that worms have no feathers and hens have no teeth. The authors use his theory to explain how Genetic modifications are as natural as evolution.

Along with all of the authors' claims, the main point the authors try to make is that genetic engineering has been going on for centuries in agriculture. They point out that the only reason genetic modification is controversial now is that scientists are using a new method to

perform the genetic modification, and are not just cross breeding plants. They argue that it is the same concept that has been accepted and used for years in agriculture. They also argue that GM foods are necessary for the sustainability of life on earth. GM foods are the only efficient and cost effective method for producing foods for vast populations of people, who are starving and in need of food. It is also a way to provide low-cost crops to people of third world countries with increased nutritional values i.e. golden rice. They claim that, even if the vitamin A fortified rice does not contain enough nutritional value to solve the problem, some nutrition is better then none. They also claim that it is our moral duty to continue to develop new ways of using GMOs because it is the only sure way we will be able to continue to feed the growing population of the world without destroying or using more land for agriculture. The authors believe that GM foods hold the promise of the most environmentally conservative way to increase food supply. They also believe that plant biotechnology can help humans to be better stewards of the earth, while allowing us to feed are ourselves and generations to follow.

Moral Conflict of Genetically Modified Foods

Against GMOs
"Seeds of Deception" by Jeffery Smith

Values
-Maintain natural integrity of crop – GM crops not natural and animals avoid them
-Avoid unknown future mutation or harm of GM crops to environment and humans – not enough independent research done on GMOs
-Avoid putting extra foreign hormones/bacteria/chemicals in our bodies – unnatural
-Conserve environment for future generations
-Avoid playing God with natural organisms
- Avoid cross-contamination of crops, especially with pharmaceutical crops
-Avoid accelerated evolution pests to form super pests

General Rules/Policies
- Mandatory labeling of GM products
- Strict rules regarding contamination of organic products, and strict separation of GM products and non-gm products
-More ongoing test and experiments to know the extent of harm GM products can cause because there is limited research about GM products
-Increase environmental and ecological education about GMOs - so public is more aware of what they are consuming
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Stakeholder
- European Government
-Independent farmer that does not use GMOs crops and animals
-Organic farmers
- Environmentally and ecologically conscious people and organizations
- Organic companies
- People following an organic diet
-Scientist and researchers who have reservations and some knowledge of the potential harms of GMOs

For GMOs
"Mendel in the Kitchen" by Nina Fedoroff and Nancy Brown

Values
- Increases crop yield
- Increases nutritional value of crops
- Increase economic revenue of crops
- Maintain an increasing population sizes and avoid starvation
- Embracing same technique that farmers have been using for centuries in agriculture
-Duty to increase crop production, by any means to feed people and future generations

General Rules/Policies
-No labeling required because GMOs are safe
-Increase use of GMOs
-Find more ways of using GMOs, in order to obtain the most nutritional and profitable products, that will benefit both consumers and producers
-No regulations on growing and trading of GMOs – so food crops are available to every one, especially in third world countries

Stakeholder
-US government
-Commercial farmers, who use GMOs in crops and animals
-Commercial companies, who use GMOs in their products
-GM food technology companies, who do research and develop new foods and organisms
-Third world countries
- Economically disadvantaged, who can not afford organic
- Environmentally/ecologically uneducated people

Hawkin's Sustainable Development Ethics

Metaphysics/Science
- Weak anthropocentric approach/humanistic view
- Does not give full environmental theory
- "Ontological commitments" of non-anthropocentric ethics are controversial and indefensible
- task is making policies to achieve allocative fairness and justice, duty to future generations, and sustainable development

Moral Principle
- Sustainable society
    - Including the economic system/business, people/consumers, and government
- Allocative fairness/justice, duty to future generations, or sustainable development (development and use of the environment which meets the needs of the present generation without compromising the ability of future generations to meet their needs)
- Long term social and environmental responsibility of business, consumers and government
    - Criterion of Moral Standing – reason
        - Members of the Moral Community – all rational human beings
        - Moral Agent – all conscious, rational human beings
            - Duties To – present and future generations of humans
                - Resources – everything non-rational/ non human (whole of nature)

Values
- Harmony with nature
- Control of human population growth
- Reduction of consumption
- Spontaneity of sustainable business and consumer choices when redesigned social-economic system in place (natural capitalism)
- Harmony of business profit motive and consumer self interest with "the right thing to do" (sustainability) when system in place
- Restoration and health of degraded ecosystem
- Respect for the ideals of the human spirit
- Long term human health
- Environmental literacy
- Secure and meaningful employment for all
- National and global distributive justice

Rules/Policies
- Twelve social re-design policies to achieve a sustainable society
    - Revoke the legal corporate charters or business licenses of grossly socially and environmentally irresponsible businesses
    - Product pricing system that incorporates present and long-term environmental costs of the product
    - Incorporate "green taxes"
    - Allow natural resource companies to be semi-public utilities with some public, governmental control
    - Change linear systems (throwing away old goods) to cyclical ones (recycling old goods)
    - Transform the making and life-cycle of products (design biodegradable products)
    - Vote/ boycott (boycott companies that don't follow environmentally responsible guidelines)
    - Government needs to guard and serve the interests of the people
    - Shift to biological and environmental literacy
    - Inventory of all living species, in order to know how fast they are disappearing and what we need to do to save them
    - Make the effects of the environment on human health a prominent issue
    - Humans should act on the basis of the human spirit and higher things (justice, virtue, spirituality, harmonious coexisting with all living things, etc)

Stakeholders
- Social and environmentally responsible companies and individuals
- Present and future generations
- Environmentally educated academics

General Problem
- The issues and problems regarding business, consumer, and governmental practices, especially in terms of sustainability and environment.

Based on Hawkin's sustainable development ethics, Hawkin would agree with the beliefs in Smith's book, "Seeds of Deception." Hawkin holds a weak anthropocentric approach and a humanistic view on environmental ethics. He believes that humans have a duty to future generations and he also believes in the theory of sustainable development. This means that Hawkins would be in favor of the development and use of the environment to meet the needs of the present generation, but not at the expense of compromising the ability of future generations to meet their needs. Thus, Hawkins would oppose Federoff's view that the on going production and research of GMOs is necessary and agree with Smiths's view that GMOs are dangerous. He would take this stand, mainly because there is little known evidence or research done on what effects GMOs will have on the environment and on future generations of humans, especially with on going use of them. Federoff claims that genetic modification in agriculture has been occurring for centuries, but it has not included extreme scenarios as it does today. Injecting hormones and genes into animals to produce larger animals or low fat alternatives, is not something that Hawkin would agree with because the effects of this would not benefit the human population directly, but would have greater direct effects on the business producers of GMOs. This would also go against Hawkins view of businesses having environmental and social responsibility. According to Hawkin, if the business that produced GMOs had environmental responsibility than before distributing GMO products to consumers, they should have performed vast amounts of independent research making sure that GMO had no potential to cause harm to humans and the environment.

Hawkin also would agree with Smith that the labeling of GMO products is necessary. According to Hawkin, environmental literacy and education is fundamental to the human

population. Labeling products would allow consumers to be aware of the prevalence of GMO, and educate consumers on what products contain GMOs. By not labeling products, manufactures and the government are not enhancing the environmental literacy of the United States population. This then becomes a problem with business and government policies, in which Hawkins finds many problems with the practices and policies of the government and business, regarding a sustainable environment.

Although, there is some evidence that through the use of GMOs, there is an increase in the production of plant crops being grown. If this is completely true, then it would help sustain the present generation with their food needs, but the expense of this is unknown. The unknown is more dangerous, according to Hawkins beliefs because GMOs have the potential to drastically hurt the long term human health of present and future generations. He would also disagree with Federoff because through the use of GMOs there would be less meaningful jobs for farmers. Hawkin believes in sustaining meaningful jobs for all. GMOs are produced by scientists in laboratories and inserted into crops and animals in order to produce hearty and healthier varieties, which decreases the land used by the crops and work done by the farmers.

Another reason Hawkin would disagree with Federoff is that he believes in the control of human population growth. Federoff believes in using GMOs to provide food for all people in the world, in order to sustain future population growth. Hawkin would disagree because not using GMOs would be a natural way to control population growth, with no possible harm to the environment. Hawkin would also agree with Smith in not using GMOs because of the possible degradation they could have to the environment. Smith believes that GMOs could cause the increased evolution of “super pests,” which could disrupt the ecosystem and become harmful to humans. GMOs could also become cross contaminated between crops and plants, which could

cause harm to the ecosystem and to humans, especially if the cross contamination is between plants used for pharmaceutical purposes and those used for food. Disorder could also occur among animals, according to Smith, because animals will not eat GMOs and if the foods that animals normally eat are produced with GMOs, they will not eat them and starve. Thus, using GMOs would only go against Hawkins value of restoring the ecosystem because it causes deterioration to the ecosystem.

Based on the research that I have done and the books that I have read about the issue of GMOs, I am stuck between the moral dilemma of producing unnatural organisms for the sake of satisfying human needs and science. I agree with Hawkin and Smith that GMOs have the potential to be dangerous because the vast unknowns of these foreign organisms. It is not fair to introduce these foreign organisms into things that humans eat everyday, with out the proper research to guarantee that GMOs will not cause damage to human heath and the health of the environment. Business that produce and GMOs have the moral and ethical responsibility to have independent research done on the effects of GMOs, and not use money to repress research that might have a negative impact on their profits. I also think that it is unnatural to inject milking cows with hormones, in order to produce more milk, and insert genes into crops that act as an insecticide. I think it goes against the way nature was intended to be and the more manipulations that humans make to earth, the more harm we are potentially in for in the future. This is just like the pollutants that we put into the earth's atmosphere everyday, from products we are making through the manipulations of natural resources, which is causing damage to the earth's ecosystem.

Although, I don't think that it is ethically right to manipulate plants and animals by injecting foreign genes into them. I would be more inclined to agree with Federoff on the

potential benefits GMO would have to present and future generations, if there was more independent research conducted on the effects of GMOs. Companies that produce GMO products pay researcher to perform tests on GMOs, in order to get the outcomes that are in favor of GMOs. Also, when independent research is done, GMO companies have the history of paying off researcher to suppress the research findings that go against the benefits of GMOs. I think independent research is important and non-bias. If it was done correctly, I think it would useful to prove to consumers and myself the actual benefits and negative effects of GMOs. This would allow consumers to make an educated judgment about GMOs, instead of worrying about the unknown effects of GMOs.

I also believe that if labeling was mandatory on products that contained GMOs, consumers could make educated decisions on the products that they buy at the store. Labeling would agree with Hawkin's value of environmental literacy, by educating the consumer of GMO products in their diets. Labeling in the United States is not mandatory and most consumers have no idea that the products that they are buying contain GMOs. A problem with labeling is that some producers have no idea if their products actually contain GMOs because there is such a high rate of cross contamination, which could come from transporting crops and wind pollination. This could be overcome if there were stricter regulations on the production of GMO crops and products. As a consumer, I usually buy organic, and want my products to not be contaminated with pesticides or GMOs. I think it is the right of the consumer to have these expectations upheld, and restrictions are necessary in order to do this. Labeling would also make the consumer become aware of how prevalent GMO were in their diets and allow them to make ethical decisions about the foods they were eating.