Everything You Know About GMOs is Wrong

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GMOs. You're not 100% certain what they are, or even what they stand for, but you know they're bad. You've seen moms at Target attacking each other for not buying organic apples for their kids and you've heard celebrities urging their fans to reject transgenic foods. Hell, even your local Chipotle just went GMO-free. These conservative opinions and misinformation have led to public debate over progression in biotechnologies, specifically, genetic engineering.

What if I told you that all this negative hype surrounding GMOs is on the wrong side of the debate? Because in this case, popular opinion is not the educated opinion.

Beyond the impact of GMOs on your everyday life, there are modern problems threatening stability on a global level. Genetically modified organisms hold the key to neutralizing threats of climate change, dwindling of fossil fuels, widespread famine, and economic losses tied to agriculture. Therefore, it is vital that the work on developing transgenic or genetically engineered crops continue due to the implications of social progress as well as environmental benefits.

A Brief History Lesson

GMOs can be explained very simply. Organisms, both plants and animals, have their genetic codes manipulated by humans to select for the most desirable traits. This is by no means a revolutionary concept. In fact, humans have practiced a more bare-bones form of this called "domestication" for thousands of years, and it completely reshaped the course of human history. People were finally able to settle permanently, raising crops and breeding specific plants to achieve more appealing harvests, and tending to animals like chickens and pigs, breeding the largest ones for greater meat yield. This resulted in a complete transformation of the original

organisms into the ones we are familiar with today. For example, an ear of corn is now more than ten times the size it was normally in nature. In this way, the argument can be made that really, none of the foods we consume today are natural, not even organic ones, as they have been historically subjected to human manipulation. 9,000 years of it, to be specific.

With GMOs, progressions in science and technology allowed for this manipulation process to be moved to a lab. The first genetically modified product to come out of one of these labs was the creation of genetically engineered penicillin, which was approved by the FDA for general use in 1982 (Zhang, 2000). The introduction of genetically modified crops, the focus of this paper, was quick to follow.

The Villanization of Monsanto

It is also important to address the role that Monsanto has played in the GMO debate. For those who do not know, Monsanto is an agricultural biotechnology corporation that has operated since the early 1900s. The multinational corporation is demonized for their involvement in the Vietnam War. Specifically, they are responsible for the creation of the infamous chemical dioxin, the key ingredient in Agent Orange (Murphy, 2017). Since then, Monsanto has transformed from a chemical company into a food-focused company and are the leaders in GMO technology.

Today, they lead the way in developing the latest innovations in biotechnology with a special focus on genetically modified crops for the purposes of sustainability. They have had much success, most notably commercializing GM seeds. But no matter how numerous Monsanto's positive contributions to the world, and although they are completely unlike the company they were during the Vietnam War, people just can't let it go (Fewster, 2005). Monsanto is a household name to many Americans, and because people only know them for their creation of Agent Orange,

they are quick to reject any developments in science that come out of the company today, GMOs especially. The lack of trust that the public has for Monsanto is extremely problematic because it caused Monsanto to be synonymous with GMO, thereby adding further fuel to the fire that is the on-going genetic engineering debate. Conspiracy theories about Monsanto trying to poison the world's children through genetically modified crops are running rampant and put a serious roadblock in the way of biotechnological progress. I am not trying to convince people to forget about the horror that was Agent Orange or the devastation it caused; I am simply asking that people educate themselves on the changes that Monsanto has made and realize that the company today is not the same one it was fifty years ago.

Practicing What They Preach

As I said, Monsanto has reestablished itself, most notably in the last twenty years. In 1995, a new CEO of the company presented reimagined sustainability. The CEO, named Robert Shapiro, reiterated the world's dilemma of feeding an ever growing. Secondly, he stressed that the widespread techniques used in agriculture and science would destroy the planet if they were single-handedly employed to solve the world's food crisis problem (Glover, 2007). Monsanto stressed that the best option for environmental sustainability was through the continued development and global acceptance of genetically modified crops.

Monsanto took a very hands-on approach in implementing this technology. In 2000, the Smallholder Project (SHP) was announced. Essentially, it entailed Monsanto working with small farmers in developing countries to promote both agricultural and social growth. This project was very philanthropic in nature, and was summarized in the following way:

> Demonstration plots and farmer trials enable smallholder women and men to witness the value of technology packages that include improved seeds, crop protection products,

> fertilizers and conservation tillage practices. Training sessions provide the knowledge they need to use the new package safely and effectively. Micro-loans help them get started on their own farms, and market access assistance helps them sell their surplus crops to generate income for their families. Farmers who adopt the new technologies first help expand the effort by teaching others in their community (Glover, 2007).

The project had a positive impact on the lives of many, operating in 13 countries. But it was met with a lot of skepticism, with critics voicing concerns about the longevity of the project as well as denouncing genetically modified seeds themselves. A lot of this backlash was coming from Europe, which at the time was working to pass laws banning GMOs. (Interestingly enough, just a few years later in 2004, the European Commission lifted the ban on GMOs when it voted to allow a Swiss company to sell genetically modified corn (Murphy, 2017).) This anti-GMO movement led to Monsanto reporting a financial loss of nearly $2 billion U.S. dollars in 2002 (Glover, 2007).

As a result, Monsanto's management board was forced to reprioritize and shift away from its humanitarian focus momentarily and get the company financially stable before continuing with SHP. Ultimately, it was decided that funding for the program be cut. It is clear to me that this was not a decision that Monsanto's leaders wanted to make. It made them look even worse in the public eye and was forcing them to put GMO global expansion on hold. I argue that this all comes back to public dissent on GMOs due to a lack of understanding and misinformation. Had the anti-GMO movement not be so ignited, the SHP would not have ended. Looking to the future, Monsanto is in the process of starting new and improved versions of SHP, but, in my opinion, is waiting for both financial security and public support before they go ahead and implement them.

Addressing the Threat of World Hunger

The potential of genetically-modified crops to end world hunger lies in its ability to do three things: increasing food supplies, lowering production and consumer costs, and again, developing products to resolve specific nutrient deficiencies.

Genetic Modification: Nutritional Potential

Transgenic crops have a greater potential for health benefits than organic crops. From advertisements promoted by the organic industry to online blogs run by single moms and conversation threads on Twitter, pro-organic supporters claim conventional/transgenic crops are stripped of key nutrients. Big food corporations only want their food to look pretty, anti-GMO spokespeople argue, and it always comes at a nutritional cost. But these kinds of statements are way off base; the genes in plant DNA code for everything, and they can all be manipulated to create better products.

Just as the section of DNA that codes for the size of an ear of corn can be altered, the gene that accounts for its Vitamin C levels can also be modified (Messer, 2001). People are unaware that genetic engineering is more focused on improving nutritional value than cosmetic alterations. The benefits of this technology impact more than the ordinary public. Already there are humanitarian organizations working with biotech labs to cultivate special strains of rice to bring relief to regions of the world where malnutrition and vitamin deficiencies are common (Ghebrezgabher, 2013). These strains would improve the quality of life for many people as well as extend their life expectancy.

Supporting Agricultural Communities

Small farmers that operate on land that is less than ideal for farming are already faced with economic struggles. On average, 25% of global profits are lost due to crop diseases and pests. Considering that the economies of third world countries are overwhelmingly rooted in agriculture, this is a huge issue (Qaim, 2001). Soil lacking key nutrients for plant growth and adverse climate conditions only spurred on by global warming make it nearly impossible for farmers to harvest

crops of adequate sizes (Gioietta, 2014). Even then, the few mediocre plants that do grow are commonly devastated by pests. As a result, farming families in rural communities, in third world countries especially, are unable to earn a living. We're not talking about tremendous amounts of money; we're simply talking about enough income for the families to keep their farms and feed themselves.

Some humanitarian groups and agribusiness organizations have attempted to alleviate this problem by encouraging biotech laboratories to develop new pesticides that are more efficient (Messer, 2001). The hope has been that these new chemicals will allow farmers to produce larger harvests and bring in more money. However, this has not been the case. These poor farmers can barely afford to feed themselves, and they cannot afford the new, cutting-edge pesticides being offered to them (Qaim, 2001). Instead, the more efficient solution is to go to the root of the problem: engineer the crops themselves to be pest-resistant so farmers are not forced to buy additional, chemical supplies in the hopes of protecting their crops (Nickson, 2008).

Pest-Resistance

Genetically modified crops with pest-resistant traits have existed for decades. The trait given to these special crops, primarily corn and cotton, allows the plants to produce a bacterium called Bacillus thuringiensis (Bt) (Andrew, 2018). The word bacteria may sound scary when heard in relation to food consumption, but, Bt is perfectly safe for human ingestion, and does not cause food poisoning or any other negative health effects. However, Bt does produce a toxin that makes it toxic to common insect pests. Bt is naturally found in soil all around the world, and what scientists have done is added DNA material from Bt into genetic strains of crops (Pilson, 2004). The fact that these crops make their own Bt gives them resistance to insects that normally would plague farmers' harvests.

While this process may sound complex, the environmental impact is minimal. Bt does not affect the health of the farmers who maintain these crops, nor does it harm animals and livestock that live in the surrounding areas (Nickson, 2008). Furthermore, because Bt is commonly found in soil and is not limited to a specific area of the world, any runoff into water sources from the crops is irrelevant as this process happens naturally when soil erosion enters water (Gould, 1988).

Shiva's Suicide Seeds

It is necessary to address a common myth brought up by GMO critics regarding the effects of genetically modified seeds on farmers. This completely fabricated story is used as a scare tactic to turn the public against GMOs, and it is extremely frustrating to see such horrible misinformation out there. It is the favorite "case study" of the infamous Vandana Shiva, an Indian environmental activist who has made it her life's mission to turn the public against GMOs.

The story goes like this: Monsanto distributed GM cotton seeds to a rural region of India dependent on agriculture for economic stability. When this strain of seeds failed, nearly 250,000 farmers committed suicide (Shiva, 2014). At least, that's how the story told by anti-GMO activists goes. The numbers and facts have been completely manipulated. It is true that GM did distribute seeds that were not as successful as they were expected to be, and it's also true that a quarter of a million farmers took their own lives. But here is where the myth is busted.

First, the deaths were not isolated to the area where the GM seeds failed; instead, the deaths were spread across 28 different states in India (Kloor, 2014). Additionally, extensive investigations have been conducted by the Indian government have concluded that the deaths

were linked to unpopular bank reforms that caused economic hardships for the agricultural communities and that no crop, including the GM seeds provided by Monsanto, was to blame. Furthermore, Monsanto's Bt seeds, a different transgenic strain of cotton that protects the plants against insect pests, continue to be wildly popular in India, allowing the country to nearly double the annual cotton production they had before these seeds were introduced (Murphy, 2017). So, GMOs have done a tremendous amount of good for the people of India, and the claims of their role in farmer suicides have no basis in truth.

Food Security

There is no doubt that subsistence farming has a lot to gain from genetic engineering technology. However, the food surplus that could be created by GMOs would benefit not only poor farmers, but the entire populations of third world countries. These populations are prone to food insecurity. The 2008 housing crash in the U.S. set off a domino effect that caused food prices to shoot up by over 80% (Sharma, 2009). Violent riots over food shortages in countries like Haiti, Peru, Pakistan, and many more became commonplace. Even if there is food available, people typically must spend 70-80% of their income to obtain it (Qaim, 2001). These incidents have not ceased with time but have in fact been exacerbated due to other pressures like climate change. A way to combat these occurrences is to increase the world food supply.

By genetically engineering strains of crops that are resistant to pests and diseases, the harvest sizes as well as profits will increase tremendously. This increase in the total world food supply will help lower prices, and the surge in economic resources from greater agricultural success will mean that third world countries will be able to afford to feed themselves.

Scientific experts have determined the root of societal collapses to be two things: sociopolitical factors and inconsistent climatic changes that cause people to lose control of their environmental resources (Perspectives, 2005). The renowned Jared Diamond has concluded in numerous papers that a civilization is sure to disintegrate when these factors reach a tipping point (Beck, 2010). Now, climate change is no longer confined to limited regions or civilizations. Thanks to poor conservation efforts and unfriendly environmental practices around the world, we're talking a collapse on a global scale.

Counter-Arguments and Economics

Anti-GMO supporters have argued that this is just swapping one economic expense for another. Initially, their point appears to hold some weight. If poor farmers cannot afford expensive new pesticides, how on Earth are they going to get ahold of genetically engineered crops? The answer is simple. Give it to them for free. Already there has been a case of a genetically modified crop being distributed at no cost to farmers facing economic hardships. Vitamin-A rich rice, nicknamed "golden rice", was distributed to subsistence farmers in rural areas, specifically where vitamin deficiencies are common. The crop was available for free because of the efforts made within the biotech industry along with further negotiations made by humanitarian groups (Qaim, 2001). Pest-resistant strains of crops like corn already exist. If the only thing standing between making them widely available to impoverished people is a lack of communication and negotiations with the labs developing the strains, we need to start making more of an effort. This is not a shortcoming of science, but a failure of different experts and organizations working together to make social progress happen.

Combatting Climate Change

The Horn of Africa

Transgenic crops present several applications to the growing concern of climate change. Regardless of what the current government administration believes about climate change, we're already seeing and feeling its effects. Global warming has resulted in dramatic weather and climate shifts, hitting hard in areas that are already prone to extreme weather patterns. For example, the Horn of Africa has now experienced essentially on-going drought conditions for years on end. The few crops that people in countries like Somalia and Ethiopia were once able to cultivate are now no longer able to survive, and these crops can't adapt through the natural evolutionary process quickly enough; the crisis is already here (Hannington, 2002). These conditions have resulted in widespread famine throughout the region.

Furthermore, the area is also under tremendous financial strain with more than 50% of the population living under the poverty line as their agricultural communities are collapsing. Yet again, the genomes of crops are already being manipulated to endure harsh environmental conditions so that rice, corn, and grain strains will be able to thrive in drought conditions with minimal water sources (Ghebrezgabher, 2013). It is vital that the labs conducting this work continue to do so. Additionally, we should encourage humanitarian groups and charities to coordinate their efforts with these kinds of biotech labs so that scientists can receive the funding they need to afford operating and research costs. This would help ensure that time and effort is being put into the most efficient form of relief aid not only to the Horn of Africa, but to other struggling regions of the world as well. Putting genetically engineered seeds in the hands of these people would make a tremendous impact for the better.

GMOs and Hydrology

While droughts plague some areas of the world, rising sea levels caused by melting ice caps prey upon others. In coastal areas that are suffering from constant flooding, scientists are experimenting with agricultural hydrology combined with transgenic crops. They are working to create seeds designed to grow with minimal, if any, soil, and that will instead be able to draw everything they need from water (Shin, 2017). When these new strains are coupled with pest-resistant genes, agricultural success is inevitable. Farmers will have larger harvests, be able to feed more people, and make more money. If this development in genetic engineering continues, we will see more dramatic increases in the world food supply (Teshager, 2016). To reiterate, more food leads to lower prices, meaning more people can afford them and there are fewer shortages. Furthermore, research conducted by scientists like Jared Diamond have shown us that once people can generate a food surplus, ensuring their basic consumption needs are met, they will begin to break away from agriculture and specialize in other areas of work, leading to further economic development and social progress (Diamond, 1998).

Reduction of Greenhouse Gases

There are also links between GE crops and a decrease in greenhouse gas emissions as well as a decrease in fossil fuel use. There is nothing environmentally-friendly about farming, organic or not. Machinery powered by fossil fuels plays a role in every aspect of the agricultural industry, from tending the land to harvesting to transportation to market (Pringle, 2003). But GMOs have the potential to diminish the harm this process causes to the environment.

Detailed data collected from various laboratory experiments and studies show how GMOs, in this case a kind of algae called *Chlamydomonas reinhardtii*, combat the issue of

greenhouse gas emissions as their plant cells can be manipulated to take in carbon dioxide during the process of photosynthesis (Shin, 2017). This is incredible; we're talking about a plant with the power to take a harmful substance, carbon dioxide, and remove it from the air. Furthermore, because GE crops are cultivated to be pest and disease-resistant in addition to structural improvements, there is less mechanical maintenance required. Farmers do not have to use machinery to constantly spray these crops with chemicals, strategically remove weeds, etc. This decrease in equipment use directly causes a decrease in fossil fuel use as gasoline is needed to power this machinery (Pringle, 2003).

To force scientists to turn back and stop their work in this area of genetic engineering would mean completely screwing our planet and ourselves over. At this point in the game, humans need all the help they can get when it comes to fighting global warming. Turning down any possible solution is not an option. We owe it to ourselves and the planet we have damaged so much to shoot our shot with biotechnology.

Public Relations

Genetically engineered crops have a poor relationship with the public, credited largely to a lack of understanding and communication between scientists, biotechnology companies, and consumers. People fear serious health complications will result from consuming GMOs thanks to misinformation and the spread of invalid studies. The infamous Seralini study was a poorly-conducted experimental that mistakenly found a causative relationship between GMO consumption and tumors in rat test subjects (Robinson, 2013). The main issue with this specific study was that the rat species used was genetically predisposed to tumor development and thus the rats would have developed severe health complications regardless of the food being fed to them.

Overall, the procedure and results of this and other similar studies are incredibly flawed and have been discredited by the global scientific community. But despite their redaction from all scientific journals, these studies have terrified the public. In fact, there has been no widely supported evidence for health complications caused by GMO consumption.

"Please Explain to the Camera What GMO Means"

Regardless of what side of the GMO argument you talk to, there is a lot of confusion among the ordinary public. A recent documentary called "Food Evolution" interviewed several anti-GMO protesters at a rally in Hawaii. These ordinary people were asked to explain the meaning behind the signs they held (Kennedy, 2017). They bore messages like "No More GMOs", that sort of thing. Then, each person was asked what GMO stood for. The answer is obviously genetically modified organisms, but not even one of those people were able to answer the question correctly. I find this upsetting. How can the public be expected to make educated choices about the foods they consume when they do not even know what the acronym of the product they are fighting stands for?

Fighting for Consumers' Money

Another factor contributing to public disapproval of GMOs is money. It is no surprise that financial competition between the organic industry and the transgenic crop industry fight for consumers, and when it comes to marketing techniques, the organic industry is winning. One such way that consumers are pushed away from transgenic products is through marketing labels. Under FDA guidelines, food products that meet the standards for being "GMO free" and "organic" can be labelled as such. However, the problem is that the tendency of grocery shoppers is to reject

GMO products that do not have these labels, despite the overwhelming lack evidence regarding any negative effects of genetically modified foods (Herrick, 2005).

Additionally, because conventional or transgenic foods do not have labels of any kind, consumers are more suspicious, associating this lack of information with health risks (O'Sullivan, 2015). The organic industry thrives off these public misconceptions as companies can increase the price of their products because consumers will pay more for products that they mistakenly believe have health benefits. Overall, this labelling practice coupled with celebrity endorsements of eating organic and other social trends has contributed to public disapproval of GMOs and a divided consumer base (Litvinoff, 2007). All this controversy without any scientifically sound evidence to back up anti-GMO claims.

The Exploitation of Consumers

The dishonesty of the organic industry is extremely upsetting, especially when considering the economic impact on lower and middle-class Americans. They are completely being taken advantage of. The organic industry continuously promotes messages about GMOs being dangerous, such as leading to health complications in children (Abergel, 2005). For example, there was a falsified study released several years ago that went viral. It claimed to have found a causal relationship between GMO consumption and autism. It was a terrible study that compared increases in GMO consumption with the number of autistic children in the United States over the past fifty years.

What the woman presenting this information to the world failed to point out was a third variable influencing both of those factors: population growth. Over the past fifty years, of course we see an increase in the number of autistic children because there are more and more children

being born, and of course we see an increase in the number of GMOs consumed as more people are being fed (Kennedy, 2017). What's more, the woman who claimed to have found this scandalous connection of GMOs causing autism was not even a scientist at all, but a computer science major. She filmed her findings in a home video that is laughed at by the biotechnology community because it is so obviously wrong. But for ordinary Americans, the video and other widespread myths about GMOs are terrifying.

When young and financially struggling parents hear these kinds of messages and don't know any better, they are absolutely going to spend their money on organic products that they likely cannot afford because they feel responsible for their children's safety. It's a fear tactic, plain and simple. Furthermore, the nutrition and health of these poor families is very likely to decline, despite the good intentions of parents (Pease, 2004).

First, organic products are generally more expensive than conventional or GMO products, which the organic industry tries to combat with statements that bash GMO consumption (Mitchell, 2007). As a result, even people with limited budgets make the decision to buy higher-priced organic products over cheaper conventional alternatives because they believe the negative messages they hear about GMOs. They are trying to make conscious decisions that prioritize their health and wellbeing (Abergel, 2005).

However, they are not able to afford to buy as many organic products as they would conventional products, which leads to nutritional deficiencies. For example, a parent may decide it is better to buy one head of organic lettuce than it is to buy one head of conventional lettuce, a bag of conventional spinach, and a conventional tomato for the same price because they are afraid to expose their family to GMOs, even if it means they must buy smaller portions of food.

The result is that this family is missing out on the nutritional value from a variety of products because they believe that quality over quantity is the better decision to make (Pease, 2004). It is tragic to witness this happening because normally, this logic would be sound. In this case, there is no scientifically sound reason to choose organic over GMOs, and the quality over quantity argument does not apply.

Multiply this shopping practice over years and it is easy to see how people are eating far fewer nutrients, vitamins, and calories than they need for a healthy diet (Mitchell, 2007). The worst part is that these Americans are doing it to themselves all while under the impression that they're doing the right thing for themselves and their families. They are being exploited by the organic industry.

Conclusions

Many skeptics of genetic engineering love using uncertainty in their arguments. There's no telling what the future holds, they say. How can we know for sure that the key to social progress lies in genetically modified crops? You know what? They're not wrong in that aspect. Seriously, there's no arguing with that statement. The answer is that we cannot know for sure.

But our fear of the unknown should not lead to us abandoning our developments in GMOs when we have already come so far. After all, progress itself requires change. I am a notoriously pessimistic person, and up until just recently, I have feared technology and the potential it brings with it to have a negative impact. Regarding genetically modified crops, I am over this fear. There are very real benefits to reap from this science, and we have seen time and time again that technology is a vehicle of change. So, remember this statement, all the points mentioned in my

paper, and the growing problems humanity faces today. GMOs are worth the pursuit. It's on us to step up and embrace it.

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