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Rhet 105

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Rise of a Dangerous Case: Food Engineering

Working Thesis: Although genetically modified food can play a significant role in feeding an increase of 2 billion people by 2050 due to its mass production abilities and agricultural benefits, it poses greater risks to the environment that cannot be compensated for in the long term.

An Annotated Bibliography

Balbuena, M. S., et al. "Effects of Sublethal Doses of Glyphosate on Honeybee Navigation." *Journal of Experimental Biology*, vol. 218, no. 17, Jan. 2015, pp. 2799-2805., doi:10.1242/jeb.117291.

The widespread use of glyphosate, an herbicide, has become very common in American agriculture and around the world. Glyphosate is regularly used for weed control in order to prevent yields from being contaminated or damaged. However, recent studies have discovered that glyphosate has sublethal effects on non-target species such as honeybees. After exposing forager honeybees to three different sublethal concentrations of glyphosate, the study found that the honeybee navigation was impaired. For example, after a single exposure to a concentration of glyphosate, the return of the foraging honeybees back to the hive was delayed. Furthermore, after a second exposure, the honeybees displayed more indirect homing flights when compared to the control bees.

The author of this source, Maria Sol Balbuena, is a PhD student in the faculty of Exact and Natural Sciences at University of Buenos Aires. Her research consists of studying the cognitive ecology of honey bees in biotech crops as well as effects of agrochemicals in sublethal doses on honey bees. Due to the author's expertise on the field and the topics discussed, I believe this author is credible. This is a primary source published in 2015. I believe this source is current because honeybee colonies across the world are decreasing, and genetically modified crops seem to be one reason as to why it's occurring. This is a scholarly source published in the peer-reviewed academic journal *Journal of Experimental Biology*. The source uses multiple references and cites it as well. I'm interested in this source because I would like to address how genetically modified crops affect non-target species, and this source provides me with excellent data. Thus, this source is reliable for my research paper.

Brookes, Graham., et al. "The Production and Price Impact of Biotech Corn, Canola, and Soybean Crops." *AgBioForum*, vol. 13, no.1, 2010, pp. 25-52.

The commercial availability of biotech crops since 1996 has taken the United States and the rest of the world by large. In 2008, the global cultivation area of genetically modified crops reached 125 million hectares, which is a 74-fold increase compared to the cultivation area in 1996. The extensive availability of biotech crops has positively impacted global production, consumption, trade, and prices of soybean, corn, etc., as a result. For example, through the incorporation of insect resistance and herbicide tolerance into biotech crops, global soybean production increased by 53.3 million tonnes, and global corn production increased by 47.1 million tonnes. Furthermore, had biotech

crops not been commercially available, the world prices of staple crops such as corn, soybeans, and canola would be respectively 5.8%, 9.6%, and 3.8%.

The author of this source, Graham Brookes, is an agricultural economist that works with PG Economics Ltd, UK. This company specializes in examining the economic and environmental impact of new technology that are used in agriculture such as biotech crops. Brookes has written 15 papers that were published in peer reviewed scientific and economic journals. Brookes' vast knowledge and experience in the field makes him credible. This is a primary source published in 2010. I believe this article is current because GMOs continue to have an immense effect in the food economy since prices for staple crops have significantly lowered. This is a scholarly article published in the peer-reviewed academic journal *AgBioForum*. This is a journal dedicated to agro-biotechnology management and economics. The author cited various references that were used in the source. This source is reliable for my research paper because it provides me with information that indicates to the positive impact genetically modified crops has had on our society and how it will be useful for an expected larger population in the future.

Chen, L. J. "Gene Flow from Cultivated Rice (*Oryza Sativa*) to Its Weedy and Wild Relatives." *Annals of Botany*, vol.93, no. 1, Jan. 2004, pp. 67-73.,
doi:10.1093/aob/mch006.

Gene flow refers to the transfer of genes from one population to another. In the context of genetically modified crops, modified genes escape through gene flow to their wild relative species. This, however, can cause large scale problems from an ecological point of view. In order to study this risk, experiments were conducted in Korea and China

to determine the frequency of gene transfer from cultivated rice to its wild relatives, weedy rice and common wild rice. The study determined that gene flow frequency from cultivated rice to weedy rice was 0.011% and 0.046%, and the transfer frequency to common wild rice was 1.21% and 2.19%. The numbers indicate that a noticeable frequency of gene flow from cultivated rice to its weedy and wild relatives exist. On a larger scale, the transfer of modified genes to weedy rice has the potential to destroy healthy rice yields and other crops surrounding the rice production site. This is because weedy rice gains genes for herbicide tolerance from the cultivated rice. By ecologically enhancing a weed through the process of gene flow, it will lead to superweeds that can contaminate different crop yields across many agricultural systems.

While information regarding the author was very limited, I believe this source is still credible for my research paper. This is a primary source published in 2004. I believe this source is current because it addresses the topic of gene flow which is significant today with respect to biotech crops. Farmers have to be wary of their genetically modified crops passing on genes that confer herbicide tolerance to nearby weeds that can potentially ruin their yield. This is a scholarly source that was featured in the peer-reviewed academic journal *Annals of Botany*. This is a journal that is published by Oxford University, a prestigious university in the United Kingdom. The author cites the many references he used in order to support the data and analysis in the source. This source is reliable for my research because it provides me with relevant data that supports the theory of how weeds can be ecologically enhanced due to the genetically modified crops surrounding them.

Delaney, Bryan. "Safety Assessment of Foods from Genetically Modified Crops in Countries with Developing Economies." *Food and Chemical Toxicology*, vol. 86, 2015, pp. 123-143., doi:10.1016/j.fct.2015.10.001.

The recent application of biotechnology tools to produce genetically modified crops for insect and weed control have proven rather successful. Farmers regularly expect damaged field crops due to insects each year, thus, resulting in a loss of yield. This is especially relevant for farmers that grow maize. Through the use of biotechnology tools, insect resistant maize plants have been successful in controlling numerous yield damaging insects. In a similar fashion, biotechnology tools have assisted in extracting protein variants that are tolerant towards certain herbicides and applied it successfully into crops such as soybeans in order to better protect the plant. Delaney also explains in detail the safety procedure behind the genetic engineering of various crops and the beneficial aspects behind GMO's with statistics included that can prove to be crucial for food production in the near future.

The author of this piece, Brian Delaney, is a toxicologist specializing in the safety assessment of food. Delaney is a diplomat of the American Board of Toxicology and a research fellow for DuPont Pioneer, a company that uses biotechnology tools to improve human needs. I believe Delaney is credible because he has more than 20 years of experience in this field. This is a primary source published in 2015. I believe the article is current because it addresses modern issues linked with genetic engineering of crops. This is a scholarly work as well. The article was featured in the peer-reviewed academic journal *Food and Chemical Toxicology*. I believe this source is reliable for my research. I plan to dedicate a paragraph discussing the benefits and safety procedures identified

within the article as valid support for genetically modified food in my research paper in order to establish that GMO's do have some positive benefits despite the long-term risks it poses.

Mooney, Harold A. *Introduction of Genetically Modified Organisms into the Environment*. Wiley, 1990.

Introduction of Genetically Modified Organisms into the Environment by Harold Mooney examines the advantages and disadvantages of releasing genetically engineered organisms into the environment. Mooney states that it is important to weigh the risks of introducing a new organism, in this case a genetically modified crop, against the perceived benefits. Many of the factors that needs to be assessed when introducing a new organism includes the demographic characterization, genetic stability, and the ability to survive within the physical and biological environment. Moving forward from this level of assessment, **considering the evolutionary consequences of modified crops is also an important matter**. From understanding such factors, new techniques can be applied to understand the genetic structure of modified plant populations and to develop improved methods in applied ecology.

The author of this book, Harold Mooney, is an ecologist and professor in the Department of Biology at Stanford University. His research primarily focuses on the impacts of global environmental change on the ecosystem function and biodiversity. Mooney is the Chair of the Science Committee for DIVERSITAS, an international research program of biodiversity science. I believe Mooney is credible because he has published countless articles and journals regarding physiological, ecosystem and global

change in ecology. He was also awarded the Tyler Prize in 2008, which is considered the Nobel Prize for Environmental Achievement. This is a primary source published in 1990. I believe this source is scholarly because it was peer-reviewed by SCOPE, a member committee established by International Council of Scientific Unions. The book has many contributors who are members of the scientific community. The author also cites many of his references. Although the book was published in 1990, I believe it is current because the environment risks assessed within this book are leading topics regarding genetically modified organisms in the 21st century. I believe this source will be reliable for my research due to the variety of risks discussed within the book and its long-term impact on the planet.

Scott, Janet. "Giving Mother Nature a Hand." *The Illio*, vol. 97, 1990, pp. 42-43.

Professor Jack M. Widholm, a faculty member of the Department of Agronomy at UIUC, found a solution to prevent the acquisition of undesirable genes that result from cross-breeding multiple crops. By applying biotechnology methods, Professor Widholm is able to isolate specific genes that are desired in one breed of crops and insert it into the tissue of another. Theodore Hymowitz, also a professor in the Department of Agronomy at UIUC, improved soybean crops by developing a breeding program. Soybeans naturally contain a chemical that inhibits digestion in the stomach when eating raw. This poses as a problem for farmers since they would have to cook soybeans for their cattle. By successfully isolating the chemical responsible for the indigestion, Professor Hymowitz's improved soybean crops are now allowed to be fed to cattle when raw.

The author of this piece is a UIUC alumni. Although information about the author isn't available, the two professors discussed within this piece have valid credentials. Professor Jack M. Widholm and Theodore Hymowitz are both faculty members in the Department of Agronomy at University of Illinois at Urbana-Champaign. Both these professors specialized in crop sciences, thus, making this source reliable. This is a primary source retrieved from the Student Life and Culture Archives center. This is an article featured within *The Illio* that was published in 1990, which makes it a popular source. Although the article dates back to 1990, the topic is still current in the sense that food engineering is still an ongoing process within the 21st century. Scientists across the world continue to find new breeding methods for crops in order to isolate desirable genes. The information discussed within this piece is useful for my research because it can be used as a rebuttal to my discussion regarding gene isolation and the impact it has on the ecosystem of our environment.

Tsatsakis, Aristidis M., et al. "Environmental Impacts of Genetically Modified Plants: A Review." *Environmental Research*, vol. 156, 2017, pp. 818-833.,
doi:10.1016/j.envres.2017.03.011.

Two questions serve as the starting point when considering the environmental intersection of genetically modified crops: what are the potential environment risks posed by genetically modified crops? And, if GM crops are commercialized, how far will it spread undesirable effects on non-target species? An important concern surrounding GM crops are the toxicity produced by chemicals used with these crops. This toxicity, in effect, could put the lives of many non-target species in danger such as beetles, bees, and

butterflies. This is a potential problem that can affect the biodiversity of our planet.

Another concern regarding GM crops include the risks associated with gene flow and genetic recombination. The process of isolating and adding specific genes to create new breeds of crops can lead to long-term risks to the ecosystem. Some examples include the development of superweeds, evolution of new viral pathogens, etc.

The author of this source, Aristidis Tsatsakis, is a director of the Department of Toxicology and Forensic Sciences at the University of Crete. Tsatsakis has written over 1000 publications and 400 of them peer-reviewed in prestigious journals. I believe Tsatsakis is credible because he has more than 30 years of experience specializing in the field of toxicology. The source discussed many negative implications that genetically modified crops pose to the environment with in-depth details and statistical data. The author referenced many different sources within this piece and cited them as well. This is a primary source published in 2017. This piece was featured within the peer-reviewed academic journal *Environmental Research*, which makes it a scholarly work. This article is current because it addresses the many unsolved risks surrounding genetically modified organisms within the 21st century. This source can provide my research paper with evidence supporting the negative impacts of food engineering.

Venter, Hermoine J., and Thomas Bøhn. "Interactions between Bt Crops and Aquatic Ecosystems: A Review." *Environmental Toxicology and Chemistry*, vol. 35, no. 12, 2016, pp. 2891–2902., doi:10.1002/etc.3583.

Bt crops refer to crops that have been genetically modified to confer the gene *Bacillus thuringiensis*, a bacterium that is toxic towards certain insect pests. Research

suggests the chemical toxicity produced by Bt crops is putting the environment's aquatic life in peril. Aquatic non-target organisms such as larval caddisflies, beetles, midges, etc. are threatened when exposed to Bt toxins. Larval Caddisflies, for example, experienced reduced daily growth rates of more than 50% when fed Bt corn litter compared to non-Bt litter. Caddisflies are a food source to a number of higher organisms within the aquatic ecosystem. The reduced growth rate suggests Bt crops will essentially decrease the population of caddisflies which will upset the food chain balance within many aquatic ecosystems.

The authors of this source, Hermoine J. Venter and Thomas Bøhn, are both individuals with a background in environmental science. Hermoine J. Venter graduated with a degree in Environmental Sciences and Management and is currently a PhD student researching the environmental risk assessment of GMOs. Thomas Bøhn is a professor of gene ecology at UiT The Arctic University of Norway. His research interests are mainly focused on the impact of biotech crops, especially the risk assessment and effect studies of GMOs. Due to their vast experience in the field, I believe they are credible on the topic they discuss and analyze. This is a scholarly source because the authors cite the different references used. This piece was also featured in the international peer-reviewed academic journal *Environmental Toxicology and Chemistry*. This primary source was published in 2016, and I believe it's current because the topics addressed were pertaining to the risks posed to our aquatic systems by GMOs and how research should be conducted in the future for better data results. Thus, I believe this source is reliable to be used for my research paper since it will provide me with information regarding the harmful effects of Bt toxins that are present in biotech crops.