

## Should or could Genetic Engineering be used to help provide sustainable resources to Society?

As the world population is set to increase to over 10 billion people in the year 2056 (1) global demand for resources produced by plants is set to increase in a similar trend leading to new methods needing to be used to increase production. In this article we will evaluate whether [Genetic Engineering](#) is a viable method to increase and make production and increase crop security to address this issue.

Genetic engineering is a method that can be used to change the genes of animals and plants to give them preferable characteristics that can improve plant production and resistance to negative events such as pests, droughts and weeds.

Every year, there is a very large potential loss from factors such as weeds, animal pests and pathogens, varying from over 80% of cotton production to around 28% of soybean production. (2). This potential loss could be massively decreased by using genetically modified crops by making them resistant to the main factors which cause loss of crops.

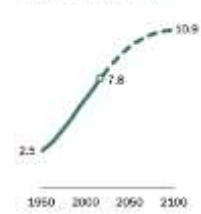
On a yearly basis, a large amount of crops are damaged or plant growth is stunted due to many factors, which lead to losses in income of farmers. There is also the cost of buying fertilizers which can damage the earth used by farmers. If an event occurs that completely destroys the crop yield, then farmers can be left without income for the entire years. This irregularity can lead to farmers lacking the money to maintain their business. The regularity that is provided by having a yield that is much more secure can alleviate a great deal of stress off farming businesses.

In a case study in the Brazilian farming industry(3), which makes up 4.44% of the Brazilian economy (\$119 billion), though a percentage of that is beef and other poultry products which are not at the moment are not genetically modified to create more efficient produce. In this study it was found that on average, 7.7% of the crop yield, up to 17.7 billion US\$, is made unsellable and therefore is lost from the economy. The potential of creating genetically engineered crops that accounting for the added costs decrease the lost crop yield by 50% there could be gains of over 8.9 Billion US\$ to the Brazilian economy this money can be used to improve farming techniques to be less damaging to the environment.

One of the main economic downsides of GM crops (genetically modified) crops is that they are more expensive, with the same species being over 65% more expensive. The price of these seeds can be even greater since the strength of the genes after a plant has been pollinated by a different plant and the preferred characteristics are much less defined.

This can be countered by imposing subsidies on genetically modified crops due to them being better for the environment or by doing government backed research so that farmers do not have to buy crops at exorbitant rates while the government does not lose money by increasing taxes, and increases food security in its country. By supplying these seeds to poorer countries as a form of aid who cannot

World population growth is projected to flatten in coming decades  
World population, in billions



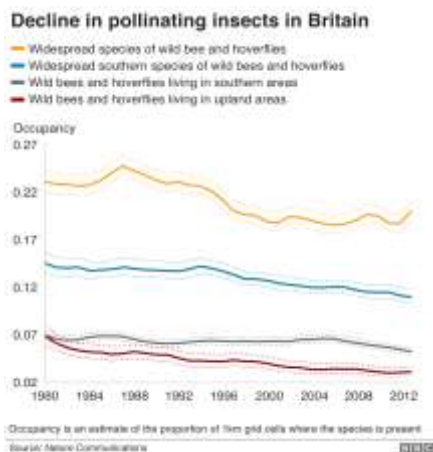
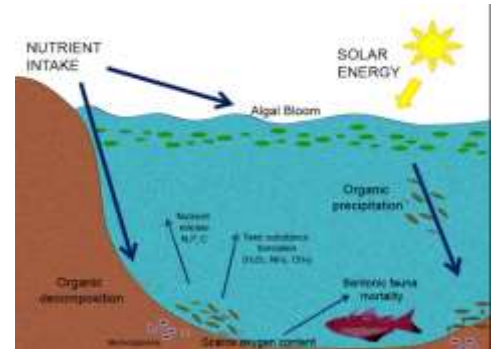
Note: Data labels shown for 1950, 2020, and 2100. Source: United Nations Department of Economic and Social Affairs, 'World Population Prospects 2019'.



afford to buy genetically modified crops from , there is even potential to massively help countries who are largely rooted in agriculture and have a large malnourished population.

The environmental impact of having to use fertilizers and pesticides, which potentially could be prevented by using genetically modified crops that have resistances to pests and can grow with lower levels of nutrients.

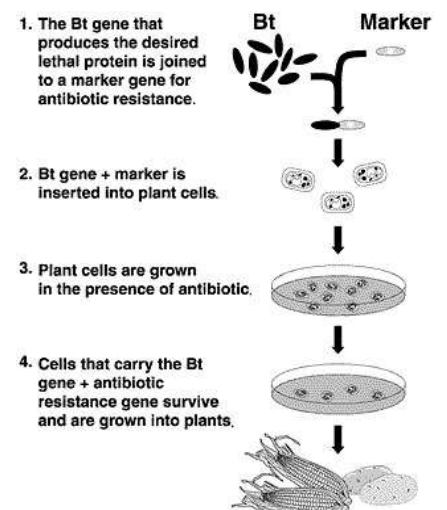
Eutrophication causes huge amounts of damage to the environment when heavy storms arrive and flooding causes the nutrients and chemicals to enter rivers and other areas. Microorganisms and algae can massively go up in number and reproduce. The growth of these species causes the level of oxygen in the water to decrease and for fish to suffocate. This can cause the water quality to decrease and cause unpleasant odors. If plants are not reliant on fertilizers then then the process of Eutrophication can be made less severe. More info on Eutrophication can be found [here](#)



This graph shows how the populations of all pollinating insects in Britain are decreasing due to many aforementioned reasons.

Pesticides are chemicals that may be used to kill fungus, bacteria, insects, plant diseases, snails, slugs, or weeds. However, sometimes when they are used to kill insects that damage plants they can have a negative effect on other insects that are necessary for plants to grow, primarily pollinators. While in the short term for farmers it makes sense to use pesticides in the long term the decrease in pollinator population will decrease the total crop in the future. If plants were able to defend themselves against pests and weeds, then the use of pesticides would not be required and therefore pollinator populations could be increased. There are other factors that cause pollinator population decrease such as habitat loss.

Pesticides are chemicals that can be used to kill detrimental insects that attack plants. However, those chemicals also can kill beneficial insects, fish, birds, humans and other mammals. However, there are more efficient deterrents to pests that do not kill other species apart from the damaging pests. *Bacillus thuringiensis*, a bacteria that occurs in soil, produces proteins that can kill certain types of pests such as European corn borers and cotton bollworms as well as some other species that can be detrimental in the area that they reproduce. As shown in figure alongside text, by using a certain section of the DNA of Bt, attached to a marker gene to a plant cell and then growing that plant cell, plants can be grown that can create those proteins that can help to protect them against pests while not having as many of the negative effects of pesticides. Since the proteins created by Bt are not lethal for all species of pests, plants that



have been genetically modified to create those proteins will not be one size fits all. However if other species of bacteria are found that produce similar proteins that can help to protect against other species of pests.

Genetically modified crops also have a potential to damage ecosystems that they are quickly introduced to since their impact on non-target organisms, whether the newly introduced crop will invade other ecosystems or whether by the process of pollination the characteristics of the genetically modified crops will be transferred to other plants(4).

Genetic engineering was preceded by the less complex, selective breeding. Selective breeding is the attempt to create plants that have the desired characteristics that will allow it to be more useful. It breeds plants through a variety of methods in a way that will exaggerate traits such as high crop yield while suppressing negative traits such as weakness to diseases. Gregor Mendel, a monk who lived in Austria during the 19th century was one of the first major practitioners of this method and discovered how genes worked. He bred peas and other plants to try to create better plants and his discoveries paved the way for genetic engineering and the creation of better crops.

The major difference between genetic engineering and selective breeding is that in genetically engineering different pieces of DNA are added to the genomes of the artificially, while in selective breeding they breed two plants of the same species with slightly different characteristics. Genetic modification allows for DNA to be added from different kingdoms entirely, such as bacteria DNA, or a different species of plant being used to promote certain characteristics (6). Bacteria DNA being introduced into a plant's genome can increase resistance to certain pests and pathogens, which increases crop yield in a way that selective breeding wouldn't be able to do. Using genetic engineering, new crops can be created much faster, with only one bit of genetic code having to be added, while selective breeding requires for multiple generations of plants to be grown. The current time it takes to create a genetically modified crop is around 10 years while selective breeding can take a much longer timeframe. With different technologies such as [Crispr-Cas9](#), it is possible to create genetically modified crops in an even shorter time. These pieces of evidence seem to hint that Genetic engineering is preferable to selective breeding.

At the moment, there are a lot of socio-cultural objections to the use of genetically modified crops. The idea that altering the genome of plants is changing the creation of a godly figure in many religions. Altering the genome of crops is in many people's eyes against the teachings of their religion and therefore should not be allowed. These opinions should be counted but if there is a conflict between using genetically modified crops to increase food production and save people from starvation and potentially angering people due to their cultural views most people would choose one option.

The growth in the world population is a major problem, due to the fact that our current production of resources that are necessary for human life is inadequate as there are thousands of people who are on a

day to day basis facing severe malnutrition and starvation. At the current time even this production of food is extremely unsustainable with around 11% of yearly greenhouse gas emissions coming from agriculture(7). However, this source does not take into account the fact that the 6% of yearly emissions attributed to forestry is largely done to increase the amount of land that can be used to produce foods which could mean that over 15% of yearly global emissions are caused by agriculture. Unless massive changes are made to the agricultural sector which could include increasing the usage of genetically engineered crops. Soy is a major cause of the emissions of greenhouse gasses but if the production of soy and other pulses, would be made more sustainable it would be much more preferable to meat in terms of the effect on the environment. It would also be able to be produced on a much larger scale more efficiently and with other sources of food potentially be able to help to solve the food problem that exists in this world.

The use of genetically modified crops is a very contentious issue in the world at the moment. But as we face immense problems, economically, socially and environmentally with the arguments that I provide in this essay I believe that to help save the world we must begin to allow for them to be used on a greater scale and invest large sums of money into the research and development of better versions of genetically modified crops. There are many arguments as to why they should not be used but the choice between the socio-cultural and economical negative effects and the potential beneficial effects of potentially being able to lift hundreds of millions out of malnourishment to me the choice is clear. This is why in this essay in answer to the question, should Genetic Engineering be used to help provide sustainable resources to Society. It should be used for the potential benefits far outweigh the potential risks.

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- (2) E.-C. OERKE, 2006, Crop losses due to pests, Cambridge University Press, **144** 31-43. 12 pages.
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- (9)