**GENETICALLY MODIFIED ORGANISMS**

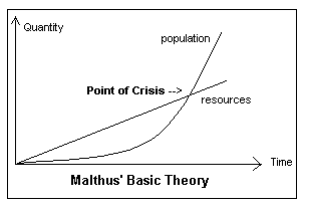
**Introduction**

Genetically modified foods can be defined as foods that have been obtained from organisms with DNA material that has been improved in unnatural ways. There is widespread use of genetically modified foods around the world. It is necessary to understand the effect it has on the environment. The degree of the impact on the environment is still being discussed, and most of the debates are not social welfare maximization or related to science (Wesseler, Scatasta, & Fall, 2011). Studies that have been done previously have highlighted concerns on the negative impact of crops that have been genetically engineered on the environment. The concerns have not been confirmed, but regulations have been put forth to ensure the negative concerns are managed (Wesseler, Scatasta, & Fall, 2011). This paper seeks to analyses the environmental benefits that genetically modified foods have and the cost of genetically modified foods to the environment.

**Malthus Theory**

Thomas Malthus, an English economist, developed the theory that linked agricultural products and population growth. His analysis identified food as a necessary tool for man's survival and the passion between sexes, which will remain in its present state. He identified these two independent variables as the natural law of humankind's existence (Borie & Hello, 2008). Malthus theory showed that if measures are not taken to regulate the environment, there will reach a point whereby the demand for food would be more than the food supply since the population growth rate increase in a geometrical ratio. In contrast, the resources increase in an arithmetical ratio.

According to Borie & Hello (2008), Malthus believed that as population increases and resources become scarce, it would lead to death, which will reduce the population and bring a balance to the natural order of things, and the cycle continues. Below is an illustration of Malthus' basic theory (Borie & Hello, 2008).



According to Majeed (2018), significant improvements have been made in agriculture since the Malthus era. Science has been used to make agriculture efficient and increase food supply in the world. Chemistry has allowed human engineering of new products that have been used to increase agricultural productivity, such as the development of pesticides and fertilizers. The development of genetically modified foods is one of the developments in agriculture that science has contributed to reduce world hunger and escape the Malthusian tension (Majeed, 2018).

**Environmental Benefits and Costs**

The impact on the environment is often in temporal and ecological dimensions. According to Wesseler, Scatasta, & Nillesen (2007), the benefits and cost to the environment can be analyzed by differentiating external and private ones and between reversible and irreversible. The analysis of the benefits and cost to the environment due to genetically modified foods requires that the cost and benefit of the non-genetically modified crops be analyzed and a clear understanding of the optimal social value from the produce. One benefit of genetically modified foods is the yield effect. These crops can reduce inputs of inorganic pesticides and fertilizers since the crops are resistant to herbicides and pesticides. These crops will thus minimize crop losses and enhance crop management, which will lead to an increase in yields. The genetically modified crops also reduce the pressure on land, which results in effective land-use effects. Further yield effect of the genetically modified crops will be observed, which is greater than the typical crops since the genetically modified foods have increased viral and fungal disease resistance (Wesseler, Scatasta, & Nillesen, 2007). The reason as to why the yield effect is considered as a benefit, is because the production of a piece of land can be increased to not only benefit the farmer by increasing his income but also benefit the population of the entire world by increasing food production.

According to Wesseler, Scatasta, & Fall, (2011), the reduction of pesticide and fertilizer use are benefits that accrue from the use of genetically modified foods. The decline of the use of pesticides is a positive direct effect that impacts the farmers since they are reduced to exposure to chemicals. The environment also benefits since there is a reduction in pesticide residue in crops and chemicals released to the environment. There is also a reduction in mycotoxins in food due to genetically modified crops' pest resistance traits. Fertilizer use has been linked to soil acidification, increasing greenhouse gas emissions, and water pollution meant for drinking (Wesseler, Scatasta, & Fall, 2011). The reduction of pesticide and fertilizer use is a benefit also because this results into a decrease in the cost of production. A decrease in the cost of production will be beneficial to both the farmers and the entire population because the farmers will have an opportunity to increase their income and it will be beneficial because the population depending on GMO will not feel the expense of acquiring food products.

According to Uchida et al. (2005), genetically modified foods have been developed to be resistant to adverse weather conditions and other abiotic stresses, facilitating marginal land productivity and providing a remedy to polluted soils. The different breeds of genetically modified crops will make farmers work more manageable since crop management is more manageable, and the crops can cope with extreme environmental issues (Sexton and Zilberman, 2011). Resistance to adverse weather conditions is beneficial because it will always ensure that there is food at all time therefore reducing the chances of people experiencing calamities like famine.

The environment's cost concerns the transfer of genetically modified crop traits to wild plants and other non-target organisms. According to research by Dunwell and Ford (2005), there is a risk of seed transfer from during processing, harvesting, and transportation, which can lead to the growth of some type of crops with genetically modified food characteristics which can further enhance the gene flow of the unwanted plant breeds. Thus, genetically modified crops' traits can cause agronomic impacts and different environmental effects (Dunwell & Ford, 2005).

According to composition Wesseler, Scatasta, & Fall (2011), the transfer of genetically modified traits of being resistant to viral infection, fungal infection, and herbicides will be advantageous to plants that lack such characteristics. The psychological effort to maintain this trait may be costly in the long-run because the diversity of plants will reduce since the natural selection will ensure superior characteristics are genetically passed, which will change the ecological composition (Wesseler, Scatasta, & Fall, 2011). Genetically modified crops have ecological concerns on the ecology's biodiversity, and such circumstances are on the rise.

According to Majeed, 2018), most studies that have been conducted have asserted that genetically modified foods have led to reduced use of pesticides and fertilizers. However, there is a negative impact on the environment due to the production of genetically modified crops. A lot of hazardous gas is released during the production process of genetically modified seeds, which have a negative impact on the environment (Majeed, 2018).

The international economic benefits of using GMO would include a reduction in cost of food which would help ensure that states can put the extra resources that were once used in buying food in other sectors that need development. The development of various sectors of their environments would then result into an improvement in the economy of the entire world.

**Conclusion**

There is inconsistent and diversity in view regarding the costs and benefits of genetically modified foods have on the environment. Most researches are funded by corporations that have vested interest in a positive outcome, which has resulted in biased findings that highlight. Thus, the safety concerns are an ambiguous issue due to the inadequate analysis. It should be noted that challenges exist in the measurement of some of the effects of the genetically modified crops being incorporated in agriculture. Most of them emphasize the environmental benefit of genetically modified foods on reduced pesticides and fertilizer use since genetically modified crops can thrive in adverse ecological conditions. However, it is conclusive that the negative impacts of crops that have been produced using genetical engineering have a negligible impact on the environment since the positive results have been biodiversity, pest suppressions, increased yields, soil conservation, and transfer of desirable traits to other crops. All this have helped in the fight of world hunger and escapes the Malthusian tension.

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