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GMO[1] - WHAT IS IT AND WHY DO WE NEED IT!?

Abstract:

Bioethical thinking regarding biotechnology should play an important role in our lives, views and legislation. The main debates have been and still are over the regulation, safety and moral status of certain applications of modern biotechnology, such as GMOs. There are fears about the technology being autonomous without public control due to its strategic nature. Awareness of technological impact on modern life is becoming more apparent as the application of biotechnology continues to develop. How then can we create a platform for handling biotechnology in a way that aligns with our views on the good life, ie. in a healthy, beneficial and environmentally sustainable way?

This article therefore raises for discussion some important issues to consider regarding the ethical dimensions of technology and how it is used. Is it applied to the greater good? And do current regulations, or the lack of them, violate our responsibilities to others by not allowing them to choose whether they knowingly and voluntarily assume the risks of ingesting these GM substances?

Keywords: *GMO, bioethics, biotechnology, nature, responsibility.*

"Genetic engineering is changing the semantics, the meaning of life itself We're trying to usurp the plant's choice. To force alien words into the plant's poem, but we [have] a problem. We barely know the root language. Genetic grammar's a mystery ....
We've learned a lot about the letters-maybe our ability to read and spell words now sits halfway between accident and design-but our syntax is still haphazard. Scrambled. It's a semiotic nightmare"

(Ozeki, 2003: 124-125)

[1] GMO - an abbreviation used to denote genetically modified organisms, which are usually able to reproduce, but not products obtained by means of GMOs.

Introduction

Humanity is changing at an unprecedented speed, and for the first time in its history, society is trying to control the hitherto insufficiently known transformation of the living world. Man, the only living being who is capable of observing his cells and delighting in the sight, now produces not only bacteria, viruses and plants, but also hybrid, even "cross-bred" animals, which have inherited transmissible traits originating from the genetic interior of a different species.[2]

Moreover, man today makes a change that is unique in its meaning - the insertion of a human gene, a dog gene or a microbe into corn, which becomes a reality. Precisely because of this, from the beginning of 2004[3], a heated debate began, first in agriculture (about whether GMOs[4] are a kind of horror or a response to hunger caused by the increase in the number of people in the world), and later in medicine and pharmacy. This is because "the promotion of genetically modified products is (from the beginning) promoted by euphoria, scientific triumphalism and mythology. One of the most frequent myths used to convince the public to accept the inventions of GMO technology without resistance is the one that promises efficient nutrition for the hungry and the poor." (Vrčak, 2010: 105). In this context, a dilemma arises: is GMO the answer to world hunger or a kind of horror because more and more "the final solution to hunger offered in the world in the form of recombined DNA methods resembles a mantra regularly used by spokespeople of agro-biotechnological companies, and also by others scientists, who spent their careers on breaking the genetic wall." (Ibid.).

So, the stakes are diverse: economic, ecological, health, political, scientific, legal... but basically (bio)ethical, because this issue fundamentally changes our understanding of life. The latter, is due to the fact that humanity for the first time industrially began to create new forms of life using artificial genes obtained from the plant and/or animal kingdom, and using methods that transcend gender barriers and change genetic inheritance.

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[2] The latter outlines a radical difference between the genetic manipulations and hybridizations that have so far traced the development of agriculture.

[3] It is an international conference on GMOs, held in Kuala Lumpur (Malaysia).

[4] A genetically modified organism - which, according to European regulations (primarily in Directive 90/220, which is accepted today in most parts of the world) - is any biological entity that is capable of reproducing or transferring part of the genetic material, whereby it has been modified "in a way that it does not naturally perform via multiplication and/or via natural recombination". Hence, it is indicated that those obtained with in-vitro fertilization, conjugation, transduction or transformation will not be considered as GMO organisms. Contrary to Europe, the USA considers them to be a food product, just like other products, so it does not label them. Any GMO that is on sale usually includes multiple false transgenes, even a plasmid sequence, as well as a gene removed from the organism.

Bioethical approach

In this sense, dealing with the issue of genetically modified organisms, which is impregnated with a large number of different controversies, does not belong only to the natural sciences - especially molecular biology, which is inclined to offer humanity this genetic modification of the information string as a precise and efficient correction of all errors in the development so far in the field of nutrition , health and environmental protection - but also social sciences and humanities that do not see the recombined DNA method as the final solution and truth. Precisely because of this, all theoretical, practical and technical issues related to GMOs must have a holistic approach, i.e. that they do not observe individual dimensions of the problem.

So, by living in an era that we characterize as the era of scientific and technological civilization, anthropocentically based on the Baconian concept of "knowledge as power" that allowed us to rule, even seemingly, with nature in our favor, it simultaneously asks us to redefine the limit of our understanding of the future through the insistence on the concept of responsibility[5]. This is so because our powers have exceeded the end point and now represent a danger to the survival of man and life in general. "With the discovery of atomic energy and the development of genetics to the possibility of directly interfering with the genetic structure, humanity has reached a turning point where it has become possible to destroy the entire planet with the power of the atom or the entire bioethical community by contamination with foreign genes." (Jonas, 1990: 40).

It could be said that, in particular, the appearance of genetic modification of living beings, as well as any other form of manipulation over life, historically marked, or should have marked, the end of this era of scientific-technological civilization. In this context, for example, man today is faced with a problem that is very complex and controversial in terms of its meaning and consequences - the production and trade of GMOs. This is so because it fundamentally changes our understanding of life, "primarily because genetic modifications encroach on the genetic potential and thus potentially leave far-reaching consequences on the germ line, and thus on life as a whole." (Kelam, 2015: 17).

As Ulrich Beck has stated, the contemporary society can be seen as an "experimental" society. With "experimental" society Beck wants to emphasise that society is being subjected to experiments over which it has no direct control and are often unknown to it. What has made the transforming of society into a laboratory is according to Beck that "science and the technology spree, with which the industrial age feeds and irresistibly drives its transformation of the world into world markets, take place as a kind of undemocratic, permanent change in all areas of life, and may even openly contradict the schoolbook rules of democracy." (Beck, 1995: 101).

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[5] Futher look Dževad Hodžić, *Odgovornost u znanstvenotehnološkom dobu*. Arhipelag, Sarajevo, 2008, p.p. 12-13.

The quote can be seen as a synthesis in the extensions of two widely known concepts. The first is Langdon Winner's concept of "autonomous technology" which he describes as the "general label for all conceptions and observations to the effect that technology is somehow out of control by human agency." (Winner, 1977: 15). It has often been argued that technologies such as GMO technology is in danger of being an autonomous technology as the public concern for legislation are put aside for the interest of a global market. In public polls such as the Eurobarometer, people express a fear of gene technology being "autonomous" as their power to have any insight in the decision-making concerning the development and market release of GMO products are difficult to employ.

The other concept is the issue of "legitimation crises" in Western societies, which Jürgen Habermas developed in the 1970s. Habermas mean "those crises are results from unresolved steering problems in the society." (Habermas, 1976: 4). Legitimation crisis then, is a result from an increasing coupling between the political system and the economical, which must be legitimated through some administrative decisions. "When the decisions of democratic institutions are been taken more and more independently of the citizens motives, these institutions experience identity crisis." (Habermas, 1976: 36 and 75.) These identity crisis gives rise to steering problems which might end up in legitimation crisis. "The legitimation crisis can be avoided if the pressure for legitimation to which the administrative system is subjected can be removed." (Habermas, 1976: 93). One can ask if it is the lack of motives that are contributing to the public mistrust concerning GMO products. That the issue of GMO has caused steering problems for the political system is something that has been quite clear under the 1990s.6

Technology innovations such as releases of genetically modified organism into the environment and the food chain, without a certain knowledge about possible effects and the probability of unknown effects has contributed to the conception of the society as a "laboratory". In legitimate crisis concerning the risks with GMO and public acceptance the question of who are in position to define risks are actualised. There is a strategically element in the social construction of risk: "It is the particular reliance on both interpretation and expert systems that have made risks the object of one of the most effective discursive strategies for changing the political horizon of modern industrialized society…"(Adam & Beck and van Loon, 2000: 4).

In order to use these discursive strategies of risk there must be expertise mediating knowledge in order to legitimate those strategies. Hence, it seems, it is no longer "interest" that dominate the political horizon but instead different claims about the legitimacy of particular forms of expertise and knowledge. (Ibid.)

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[6] The new EU directive (2001/18/EC) concerning deliberative release of GMO can be seen as an attempt at removing the pressure for legitimation.

In other words, and while at the national level, countries still have different attitudes in relation to the strategies they need to undertake because the stakes are too high, on a global scale, the polemic, which is passed on by euphoria, scientific triumphalism and mythology, is still ongoing precisely because increasingly believes that "the right to deal with issues arising from the appearance and application of genetically modified organisms does not belong only to the natural sciences" (Vrček, 2010: 7). Therefore, it is not good to avoid such questions, nor to oversimplify them, as is usually done by "the flagship of modern science - molecular biology, whose bearers are often inclined to locate final solutions (and truths) using the recombinant DNA method"(Ibid.).

This because, bioethical consideration regarding biotechnology have to have an important role in our lives, standpoints and legislation. The central debates have been around regulation, safety and the moral status of particular applications of modern biotechnology, such as GMO. There are entertained apprehensions concerning that the technology is being autonomous without public control because of its strategic character. The consciousness about the technology impact on contemporary life is getting more and more obvious as the application of biotechnology continues to develop. How can we then create a platform for handling with biotechnology in a way that harmonise with our views on a good life, i.e. in a sound, beneficial and environmental sustainable way?

As a possible matrix for giving a "good sound answer" can it be the proposed structure of Debra Strauss, an Assistant Professor of Business Law at Fairfield University, Charles F. Dolan School of Business, in her paper "Defying nature: the ethical implications of genetically modified plants", published in *Journal Of Food Law & Policy*, (Strauss, 2021), as a check box and also as a iniciator for investigating again and again the "promised land of opportunities"!

II. THE FAILED PROMISE
A. The Reduction of World Hunger
B. The Reduction of Pesticide Usage
C. The Improvement of Nutritional Content
D. The Increase in Farmers' Income
E. The Potential Risks

III. THE ETHICAL ISSUES
A. Respect for Nature and the Value of Life
B. Consideration of the Environment
C. Rights and Responsibilities
D. Equity, Power, and the Economically Disadvantaged
E. Conflicts of Interest in Public Research

The general myth about GMOs

The "story" began on April 2, 1953 in the Cavendish laboratory in Cambridge, when James Dewey Watson and Francis Harry Compton Crick were finishing the scientific article "Molecular structure of nucleic acids. A structure for deoxyribose nucleic acid" which appeared 23 days later in the journal *Nature* (Watson & Crick, 1953: 737-738) and for which they will receive the Nobel Prize for Physiology and Medicine 9 years later. They share the same award with Maurice Hugh Frederick Wilkins, whose research was a strong inspiration for Watson's scientific work, especially for Crick, known as the author of the "central dogma in molecular biology" which "overemphasizes" that the DNA molecule[7] is the most important factor in heredity.

Thus began the story of the "mother" - molecular biology and the "father" - DNA. Their article, which describes the known structure of DNA in a double helix, is the article that led these authors to the questions and problems of sequencing the human genome, to GMOs and to genetic therapy, and which further opened up a series of complexities and controversies in the next 40 years, and especially in the first two decades of this millennium. Namely, scientists analyzed and continue to work with extreme accuracy with DNA sequences, mixed genes of viruses, bacteria, humans or dogs, before inserting them into corn, examples of food or medicine production. "But even though molecular biologists are good mechanics, they still don't know the engines they work on. With the exception of certain microorganisms, they know little or nothing about the genomes of organisms, although this does not prevent them from manipulating the most complex and longest ones: acting blindly, by chance they insert new sequences into the DNA" (Сера*лини*, 2009: 26-27). This refers to the conditions when neither the detailed structure of the DNA of the evolved organisms that will become transgenic nor, *a fortiori, their perfected functioning are known*[8].

And so, after more than half a century of intensive work, molecular biology, which for its part is significantly supported by public and especially private funds[9], took over a large number of studies of the most important genes

[7] The chemical system of DNA, called nucleic, has been known since 1869 thanks to the Swiss Friedrich Misher, who somehow managed to purify it from manure and fish milkweed.

[8] The genetic heritage of plants or organisms that are called higher organisms (organisms that have a large number of cells with more specialized functions than those of organisms that are called lower) are desired only for a certain number of individuals, and within a small number of species; in relation to the main one, only certain parts of it are known.

[9] Today, it can be asserted with great certainty that the private sector, on a global level, is the most important factor in biotechnological research, thanks primarily to the assignment of research by the public sector (through licenses) and the large funds allocated for research and development (Brankov, 2013: 54).

and their primary functioning, intervening on the genome of living beings, but without one has a global and precise insight into its functioning and its structure. This is with the aim of molecular biology, which Vrchak calls a "laboratory temptation, which turns a one-dimensional sequence of nucleotides into a key for defining and understanding life" (Vrček, 2010: 7), to convince us of its apology for genetic modification as an effective correction for its mistakes regarding nutrition, health and environmental protection, and thereby reduce the entire reality of the approach, instead of a holistic and interdisciplinary[10] one, only to a reduced approach of one scientific discipline that is in "wild symbiosis" with the biotechnology industry. (Toke, 2004). And in such a chaos, what with media apologies but also anathemas, what with political and lobby tendencies to (not) accept GMOs as "seeds of salvation" (Potrykus, 2000), two extremes are conceived - "a panacea in the vision of some becomes an apocalypse in the vision of others" (Vrček, 2010: 8), so GMOs become seeds of destruction. (Engdahl, 2005).

It seems that the dangers are too big, even more so because genes are the "green gold" of the biotechnological century.

> "The economic and political forces that control the genetic resources of this planet will greatly influence the future world economy, just as in the industrial age the accessibility and control of fossil fuels and precious metals helped determine the control of the world market (...). "Patenting life is the second layer of the new operating matrix of the biotechnological century" (Rifkin, 1999: 59).

So, to be able to use the technology in a responsible way we must know the risks and values that are at stake. The main problem concerning the risks against our environment is difficulties and uncertainties to foresee the long-term effects. We must here keep in mind that GMO plants have a serious peculiarity regarding risks for the environment. If there will be a spreading of genes to the environment, it will not only be a irreversible action, but if the genes in a plant cause a evolutionary advance it will probably "take over" the natural habitat for the specific plant.[11] "It has already been experience the human inefficiency when

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[10] "...the character of the subject comes out of the focus of the discussion of one set of knowledge and really needs an interdisciplinary approach" (Krznar, 2011: 189).

[11] To prevent such spreading the "killer" gene or the "terminator" was invented. The purpose of the killer gene was to prevent plants to multiply. There was thus a strong public response on this leading to that the GMcorporation draw it back. Technologies as "terminator" force farmers to buy new planting seed every year, which threaten small farmers in the south, and is the opposite of a natural farming. Now the second generation of the terminator technology is brewing, the so-called "exorcist" technology. See Philip Cohen, "Begone! evil genes", *New Scientist, Iss. 2350, 6 July 2002, p.p. 33-36. Date of access: 27.05.2024. Briefly, the exorcist technology remove the "cassette" of engineered genes in the plant DNA by have a on/off switch that are triggered by a special protein. When the crop has*

it comes to stop non-indigenous rogue species that have gone out of control and caused enormous economical damage, for example, such as fire-ants, zebra mussels, or killer bees in the Western Hemisphere, or Chinese mitten crabs in Europe" (Dommelen, 1996: 15).

There are thus great risks at stake at a context of uncertainties that increase by time. What must be determined is if GMO in agriculture is the right way of creating a sustainable agriculture for feeding a growing population concerning the risks for the environment in a long-term aspect. A more direct effect is risk connected to consuming GMO food.

In the present-day situation, the main purposes for developing GMO products are economical profit. The allurement concerning economical profit has also contributed to the public anxiety regarding GMO products. Can the companies be trusted to put safety, which is expensive, before Economical interest when many companies have difficulties raising enough capital even to stay in business? Another question concerns our responsibility towards future generations and their rights (if any?) of a non-polluted GMO environment.

And who can blame the adversary's anxiety towards GMO technology if one starts to reflect of the poor record of responsible actions in the twentieth century that man can show up. It makes it difficult to deny with conviction that the existence of the risky potential will not result in damaging consequences to some extent. The possibilities seem to be beyond human comprehension regarding future application of reproductive technologies and gene therapy. Risks and ethical consideration could here be divided on one hand on the individual level and on the other on a more collective level.

On the individual level, biotechnological applications such as GMO food can involve risks for allergy or diseases. It has been argued that we know to little today about the new GM-crops and animals genetically stability. Artificial changes can expect to be less stabile than the hereditary disposition that has been developed under thousands of years. Mutations can also unexpectedly arise. Worries concerning our "know-how" about how genes act together and what might happen when you alter the orders of genes in plants and animal's germ plasma has also been expressed. Therefore the need for a legal framework that protects the integrity and vulnerability towards the individual is needed, not only in Europe and USA but also on an international level.

On the collective level we must recognise that the advances in biotechnology have the potential to transform our society and the social life in drastically ways. And therefor must the future of biotechnology be submitted to public deliberation in order to reduce anxiety and secure that the science and technology of genetic engineering is rooted in common shared values of respect, dignity and integrity in society.

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growth up, the special protein is sprayed over the crops and the "gene-cassette" is released from the plants DNA.

Given the scale of the potential implication, the future horizon of biotechnology is shrouded in obscurity, where optimism and anxiety mingle. So, in the ethical and moral sphere of GMO-technology the concept of risk and responsibility cut through all areas of its application.

Controversies surrounding GMOs

The use of GMOs today is large and immeasurable, namely, in the treatment of genetically determined diseases, xenotransplantation or in the production of drugs. For more than 25 years, human recombinant insulin has been produced, followed by the vaccine against hepatitis B, a large number of other preparations important for the prevention and treatment of diseases produced with this technology - alpha 1 trypsin, glucagon, thyrotropin, blood clotting factors, immune mediators and the like.

And while the use of GMOs, i.e. genetic engineering in medicine and pharmacy, is accepted worldwide, the use of this method in food production still causes great reactions in the public and professional circles because of the potential danger to the environment and human health, even though modern biotechnology has the greatest practical application in agriculture by creating genetically modified plant species with improved properties.

In this context, genetically modified organisms, protected by the property rights of several multinational companies from the USA, Argentina and Canada[12], were created in the 80s of the last century with the aim of replacing plants that are part of the basic diet of animals and humans (primarily soybeans and corn, in the form of a mixture of soybeans and corn as feed for animals and lecithin from soybeans and corn starch as feed for humans and animals). But at the same time, the prescribed rules for labeling these nutrients obtained from genetically mixed seeds were not prescribed by the largest producer countries, in contrast to 130 countries, including the European Union, which decided to evaluate, detect and recognize them in imported products, with methods and criteria that each of them should define for themselves.

Without going into the historical dimensions of GMOs, in this whole debate about the accelerated acceptance or rejection of GMOs in everyday use[13], arguments FOR and AGAINST the use of these organisms are offered to a large extent, but most often without distinguishing between types of GMOs and

[12] Countries that account for about 90% of the production of these cultural plants and that do not want to join the Treaty of 2000, which was reached in Cartagena and supported by the UN Environment Program.

[13] Meanwhile, genetically modified plants continue to spread. Namely, in less than 10 years, they have expanded to nearly 70 million hectares, which is only a few percent of the agricultural land on the planet, mostly intended for feeding livestock in rich countries - and nearly 7 million farmers deal with it, of which ¾ live in developing countries and have a low income.

their goals[14], but only speaking and turning the public debate in the direction of those GMOs that were "deliberately distributed in the environment from 1995 onwards and that possess transgenes that, on the other hand, result from artificial combinations of the DNA of a large number of organisms, with the aim of withstand a high dose of herbicides or to produce its own insecticide, thus facilitating or simplifying the use of pesticides, without reducing their level.

This modifies the very arguments FOR or AGAINST, according to the offered socio-political-economic view of things. Namely, if one accepts the point of view that GMOs are one of the ways, and the most exposed one, for overcoming world hunger[15], preventing and adequately treating the undiscovered sources of a new unknown disease, and then combating climate change... (Knezović, 2007: 271-286), then we have the argument FOR, which reveals and tells the most significant about the humanistic dimension of science. Namely,

> "promoters of GMOs claim that they imply an increase in the quality and fertility of agricultural crops, an improvement in the quality of food products (longer durability and better resistance to fruit transport), as well as a better resistance of crops to diseases, insects and weeds. It is stated that GM technology aims to achieve a wider area of crop cultivation, improvement of tolerance to low temperatures or drought, and greater utilization of currently unproductive degraded lands by growing better adapted agricultural crops. The composition of the food thus obtained would be of higher quality, and enriched with essential amino acids, minerals, vitamins and calorie-free sweeteners..." (Kaluđerović, 2009: 165).

But practice does not seem to confirm this! At the same time, the use of GMOs is not in accordance with altruistic and morally justified practice, but most often in accordance with market logic and the protection of property rights of GMOs. Namely, apart from the fact that GMOs are harmful to human health, in their justification we are guided by political interest and the argumentation of hiding and falsifying the results, which is contrary to the interest for the general good of humanity: "it must be said that at the moment the largest number of things related to so called second and third generation of transgenic plants did not advance the beyond the level of proclamations (...) A special problem is the fact that the promoters of GMOs rarely state or consciously keep silent about the negative test results of these products. Thus, the results of experiments that show that GM food brings a possible risk to human health, a harmful effect

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[14] Most often, the topic is poorly covered because in many cases GMOs that are intended for food are still identified with those that are limited to laboratory use, mainly microorganisms, but also animals that have been used since 1975 to understand the structure and role of genes, and also their abilities for self-regulation.

[15] Futher see Frances Moore Lappé & Joseph Collins & Peter Rosset, *World Hunger: 12 Myths. Grove Press, New York 1998.*

on the environment or a general deterioration of the quality of agricultural crops are minimized (...) It is also avoided to talk about classic bioethical dilemmas regarding the risk of irreparable damage, as present, as well as future generations, which can be brought by a changed biological heritage. Finally, the patenting of living organisms by multinational companies is bioethically unacceptable and unfair, not only because of the creation of monopolies in the production and trade of GM plants, but also because of the attempt to achieve dominance over life itself." Thus, "today's reductive methods of genetic engineering, toxicology and assessment of environmental consequences serve too much the interests of certain groups of people, but not enough the interests of the wider community" (Weirich, 2007: 223). And the public has the right to know about GMOs, primarily in food, because it is a fundamental right related to biological safety.

Even more, clinical trials on humans related to GMO foods, above all, have not been done, as well as attempts to determine biological safety and health correctness, related to indirect studies. Conclusions about potential hazards are partially based on animal experiments, but mainly comparison with an equivalent is used to a significant extent. Although there are many opinions, there is little information about the potential health risks of GMOs, primarily due to the financial lobby and companies, so we must be aware that the potential dangers to human health due to the indirect impact of GMO foods have not yet been determined.

Not to mention the impossibility of taking care of the environment, i.e. the so-called the "rape of life circumstances" in which the entire living world exists. In support of this is the fact that even after 25 years of experimentation, widespread GMOs in 99% of cases are plants that produce or are tolerant to pesticides, i.e. it is unsustainable agriculture that needs to respond to the problems of world hunger.[16] And when one day the land is exhausted, what will be offered in its place?

So, overall, all these promises, let's say about growing plants that will have improved nutritional properties, resistance to drought and salinity, or even produce drugs..., turned out to be too optimistic (Holdrege & Talbott, 2008: 7), because the main reason is the fact that the entire construct of genetic engineering is based on the main wrong dogma: one protein - one gene! Namely, after the project of deciphering the human gene was completed, it was discovered that man does not have 250,000 genes, as was previously claimed, but a total of twenty thousand genes, and that one gene can code for several proteins! This is the main reason for the problem with GM crops - you cannot know which gene will be activated and in which place!

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[16] Information on the commercialization of GM plants can be viewed on Clive James' website - http://www.isaaa.org.

Conclusion

Even after 40 years since the introduction of genetically modified organisms, protected by the property rights of several multinational companies from the USA, Argentina and Canada, with the aim of replacing plants on a global scale that are part of the basic food of animals and humans, i.e. after 40 years of constant progress in the agro-industry - we, as part of the European soil, are still struggling with the dilemma of whether and how to tell the consumer what he really eats and to offer him a choice, while at the same time we consider ourselves to be nations that show an ear for public opinion and sensitivity to problems in the environment and the direction in which society is moving.

This is precisely why it is necessary to urgently (bio)ethically reflect on the essential dilemmas that are imposed by the planned release of GMOs into the environment, but also by the import of products containing GMOs. We should stay awake and be aware that there are essential questions that are not good to avoid, nor to oversimplify, because it is an attempt to reevaluate the very concept of life and man, which opens Pandora's box. Scientific modesty and ethical reevaluation are needed in the direction in which man is moving, as well as respect for the biosphere and humanity!

From an (bio)ethical perspective, the problem is not that this technology exists, but how that technology is being used. This lectgure-presentation has raised for discussion some important issues to consider as to ethical dimensions of the technology and how it is being utilized. Is it being applied towards the greater good? Are genetically modified (GM) plants being cultivated to produce food for the masses, or to create profits for a company whose seeds have been genetically modified to require purchase every year and not regenerate as farmers have done for centuries in order to make their living? Are GM plants being used to help the environment, or is there a greater potential for harm to human health and the environment? And do the current regulations or lack thereof violate our responsibilities to others by not allowing them a choice as to whether they knowingly and willingly assume the risks of ingesting these GM substances?

If anything, this new technology should be used to assist lessdeveloped nations, rather than to further the disparities in natural resources and technical expertise between the United States and economically developing countries. Accordingly, research should be directed towards eliminating world hunger and lowering the barriers to food distribution. While the development of Golden Rice is certainly preferable as an ethical matter, note that this justification for bioengineered food has been revealed to be flawed, as an oversimplification of the problems of world hunger, vitamin deficiencies, and more complex social issues. Biotechnology should not be used to divert important resources from researching and applying more sustainable solutions for world food security.

Raising global concerns, the World Health Organization (WHO) study concluded that there is a need to discover opportunities where biotechnology

can contribute to the secure generation of nutritious foods in keeping with regional needs, recognizing that "[s]uch opportunities should be based on sustainable food production preserving biodiversity and respecting the values of nature, while taking into consideration ethical objectives and social equity in respect to regional conditions, needs and wants." (World Health Organization, 2005). Thus, a secure future would encompass a respect for nature and the value of life, consideration of the environment, rights and responsibilities of all stakeholders, equity, and distributive justice. As proposed, fully informing the public and transparency in the regulatory process are key.

The ethical implications are clear, followed by the expectation that the legal system will fill in the ethical gap as it has done in so many other areas and, at the very least, require labeling, pre-market approval, and monitoring of Genetically Modified Organisms (GMOs) in food products and ingredients. EU law takes into account ethical issues.[17] It is morally imperative for U.S. law to do so as well. The government must fulfill its responsibility to protect its citizens, respond to their concerns, and not betray their trust by forcing them to bear the risk of GMOs without informed consent.

As one scholar has queried, "[w]ill we be able to make ethical choices about what is humanly desirable, or will society become progressively more enslaved to the 'free-market' dictum that whatever *can be done will be done?"* (Tokar, 1999). Some opponents of genetically modified foods have labeled them "Frankenfoods" (Applegate, 2001: 207-263). The origins of this analogy, as a reaction to the proliferation of untested technology with consequences that are as yet unknown, cannot easily be dismissed. Perhaps policymakers should heed the advice of that classic moral: "Learn from me, if not by my precepts, at least by my example, how dangerous is the acquirement of knowledge and how much happier that man is who believes his native town to be the world, than he who aspires to become greater than his nature will allow." (Shelley, 1831: 39).

"Fundamentally, genetically engineered crops substitute human wisdom for the wisdom of nature." (*Against the Grain-Part 2, 1999*). Our society has yet to address the ultimate issue, particularly regard to Terminator seeds - should mankind be usurping the basic functions of life?

Therefore, we must take into account and analyze the ethical, ie bioethical dimension, which is often overlooked in discussions. We must make the same implicit, and which, due to its integrative nature, does not refer only to abstract ethical principles and their "mechanical" application in the discussion of individual problems related to human life and life as a whole, but unites all other aspects, revealing issues that remain unnoticed if the problem is reduced to only one or another dimension, biotechnological or economic.

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[17] See, e.g., *Council Directive* 2001/18/EC, 2001 O.J. (L106). http://binas.unido.org/binas/regs.php (regulating and restricting the distribution of GMOs and foods containing GM ingredients; including language that the Directive "improves transparency of the decision-making through consultation and reporting on ethical issues and the involvement of the public in the authorization process"). Date of access: 27.05.2024.

Even more, as "capital must search for new colonies to attack, and exploit them so that it can continue to accumulate (...) these new colonies are the internal space in the body of women, plants and animals. Resistance to biopiracy is resistance to the ultimately colonized future of evolution, as well as the future of the relationship of non-Western traditions to nature and its knowledge. It is a struggle to protect the free development of diverse cultures. It is a struggle to preserve cultural and biological diversity." (Shiva, 2006: 13-14).

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