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## Hunger and sustainability

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### ABSTRACT

This paper examines the problem of world hunger and discusses potential solutions to it. It reflects on the debate about whether transgenic foods should be used, which is more of a social controversy than a scientific one. Sustainability is considered a key driver for innovation that can be used as a basis for assessing the problem of hunger in the world, and the question is inseparable from its ethical aspects. Given that economic growth does not directly equate to human development, this paper states that it is necessary to address the problem of poverty and hunger from the capacity development framework according to human rights. Poverty causes disability by limiting human development; it creates the conditions for the violation of human rights; therefore, an institutional framework and social initiatives aimed at protecting the poor should be established. Finally, the main lines of research in the field of biotechnology are outlined, such as the development of genetically modified organisms and the need to continue defining methods, based on the development of capabilities. Such capabilities should be embedded in educational programmes, to establish guidelines that are incorporated into curricula as transversal orientations to be able to make sustainability a social reality.

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## I. Introduction

This paper analyses the problem of world hunger, considering its fundamental quantitative and qualitative aspects in the context of the current demand for sustainable resources and solutions. Considering the spirited social and scientific debate on genetically modified organisms (G.M.O.s), which transcends the media and influences public opinion, this paper offers some reflections that may be relevant to a broader analysis of the problem. These reflections will provide further solutions to the scientific debate from an interdisciplinary perspective, seeking to establish an ethical reference point, which should prevail. This paper also seeks to mention every objective.

In this analysis, emerging food trends must become a priority, such as, for instance, biofortified genetically modified (G.M.) crops, which are often excluded

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from the social debate without any valid scientific evidence being cited. Given that the problem of hunger is deeply rooted in the problem of poverty, and that evidence indicates that economic growth does not directly lead to human development and progress, there is the need to also consider this problem from a sustainable solution standpoint, based on ethical criteria, and to adopt a broader view of the problem of hunger and poverty. This perspective should be based on a capacity development model, taking both the dignity of the human being and human rights into account. It might also be beneficial to consider including this emphasis on environmental and social sustainability into training, educational and research programmes, and some ideas will be provided in this regard.

Finally, some of the main research lines that are currently underway are examined, which are very pertinent in illuminating viable and sustainable solutions. The main objectives of our research (i.e., the analysis of the possibilities and solutions provided by food biotechnology and biosafety, the applications of C.R.I.S.P.R./Cas9, and the role of phytobiomes) are also examined. All of these are subject to implementation bearing the concept of sustainability in mind, which is considered paramount to any technical development. All these advances and innovations should be evaluated and developed in a new, inclusive social framework, which competent authorities and international organisations should assess and implement.

## **2. World hunger and emerging foods**

### ***2.1. Analysis of world hunger: the problem***

At present, world hunger continues to be the greatest challenge faced by humanity. From the dawn of civilisation, man has been concerned about ensuring survival by guaranteeing an adequate, nutritious and safe diet. Many thousands of years later, this continues to represent an ambitious challenge. Approximately 815 million people in the world are currently suffering from hunger, meaning that 11% of the world's population suffers from chronic hunger or is undernourished (FAO, IFAD, UNICEF, WFP & WHO, 2017). Although it is true that in the last decades there have been very significant advances, especially in the reduction of undernourishment, this last year the results seem to confirm an upward trend in hunger figures.

These are not empty figures; these numbers illustrate people suffering and in pain. In our world everyday people die due to lack of food, while others die due to issues caused by obesity and being overweight (Lozano et al., 2012).

In terms of the world hunger problem, one of the main constraints in the development and implementation of adequate strategies and programmes is that the world's population growth and the increase in life expectancy should be considered both in the medium and long term. Both factors make it more difficult to ensure that the entire world population has access to food that fully meets nutrition needs.

Combating hunger is not only about ensuring the intake of a certain number of calories per day but also about these calories being nutritiously beneficial. Therefore, fighting the food insecurity that exists in many latitudes is a priority from two perspectives: quantitative and qualitative. The entire world population should have access to adequate food in adequate quantities and to sufficient nutrition in order to allow

for the full development of capabilities. The latter is a central axis of our research work and more detail will be provided on this subject later on.

World hunger is a growing and ever changing grim issue. One does not need to go far to find examples. This past year, the Food and Agriculture Organization (F.A.O.) confirmed that the number of countries that need external food aid for their population to survive has increased. The prolongation of some armed conflicts as well as adverse and aggressive weather conditions both contribute significantly to this. The majority of these are African countries that experience low or very low income levels linked to the food deficit, and even experience famine situations in their local populations (FAO, 2017). Too often, conflicts and wars have a devastating effect that destroys small and medium-sized rural farms that were the mainstay of many communities. The shortage suffered by these populations, alongside low levels of income, hinders the production of their own food and external access to it.

On the other hand, the international organisation has also shown that there is an increase in the price of basic agri-food products such as milk and the main cereals (i.e., wheat and rice) (FAO, 2018). This reflects how complex it is to face a problem that combines geostrategic, political, environmental, economic, human, ethical, philosophical, biological factors, etc. and even theological factors.

Addressing food security and managing to reduce the number of people who are vulnerable to hunger and guaranteeing quality and food security constitutes a complex issue that requires an interdisciplinary and methodological approach; this must integrate all the dimensions of the global challenge, and the interrelation between its causes and consequences, in order to be able to propose effective solutions.

Regarding the latter, our research aims to offer a vision about the problem of hunger, integrating contributions from various fields of knowledge, from the perspectives of experimental sciences, social sciences and humanities. Our novel, integral approach seeks to thoroughly analyse the problem of world hunger in all its dimensions by using new parameters and concepts in order to raise awareness of the extent and repercussions of this serious problem.

In short, the present paper provides an introduction to different existing approaches in order to propose solutions to very pressing problems such as hunger, poverty and sustainability, considering the most controversial aspects of the new proposals.

## **2.2. The transgenics debate**

As stated at the beginning, hunger is still the main problem faced by humankind, and ensuring access to food for a perpetually growing population (UN, 2017) is one of the most complex factors. In the medium term, the demand for food is expected to increase, which will cause an increase in the pressure placed on production systems. In 2009, the F.A.O. warned that if no additional measures were implemented the goal proposed in the Millennium Goals of eradicating world hunger by 2030 would not be achieved (UN, 2009). This past year, another study warned again that it was necessary to implement a large transformation in agricultural systems, since

conventional management does not seem to offer enough production to meet this growing global demand for food (FAO, 2017).

In this context, one of the most heated debates in the world today is the one which addresses the application of innovative techniques of modern biotechnology in traditional agriculture – in other words, the development of transgenic foods or G.M. crops.

More than three decades after the creation of the first transgenic plant, it is still surprising to see the great development that has taken place during this period in genetic engineering applied to crops. At the same time, it is also striking to see the great difficulties that these techniques are facing in terms of practical application, especially given that their use would allow improvement in crop and soil, and development of sustainable, high-performance agriculture worldwide (Van Montagu, 2011)

In a broad sense, it is not easy to offer a general view on the development of G.M.O.s, and therefore, our starting point is that the inherent risks 'are not always attributed to the technique itself but to its inadequate or excessive application' (Holy Father Francis, 2015). It is not the technique, but the use that men make of it that is the problem. *Laudato si'*, as Jeffrey Sachs (2016) pointed out, is the most important document on sustainability worldwide, and should be seen as a guide for action at a time when there is already a global consensus on the need to protect our common home.

Returning to the need for food that is currently being considered and the increase in the expected world population, two clearly opposing positions emerge in the debate around G.M.O.s, which may be presented under the classical debate framework: in favour of them versus against them.

Very briefly, the debate can be summarised into two types of arguments: some argue that it is necessary to apply the various advances achieved in the field of biotechnology in order to achieve more efficient, resistant crops and foods with higher nutrients, especially in areas where the highest percentage of the population is in a situation of malnutrition and at risk of being unable to access food.

On the other hand, some defend that under no circumstances should G.M.O.s be released into the open environment due to their high environmental, health, economic and social risks. According to this viewpoint, purely traditional and ecological agriculture must be safeguarded.

Among the former, we may cite Sir Richard J. Roberts, who has been leading a campaign in support of precision agriculture (G.M.O.) since 2013. Another example is Golden Rice, which managed to collect the signatures of 132 scientists and experts distinguished with the Nobel Prize, as well as 12,781 scientists (Laureates Letter Supporting Precision Agriculture G.M.O.).

The use of biotechnology in agriculture allows crops to be improved and nutritional properties that were previously non-existent to be added to food (as was the case with Golden Rice) and the food production can be quantitatively and qualitatively improved. This new form of agriculture can decisively contribute to alleviating world hunger, particularly in regions where, for climatic, orographic or other reasons, there are greater difficulties in obtaining food following traditional techniques.

Regarding the problem of biosecurity, some of the concerns that G.M.O.s have raised refer to their possible impact on human health. The safety and security of all

foods, additives, preservatives and other chemical substances added to food have been regulated worldwide by the Codex Alimentarius since its establishment in the 1960s by F.A.O. and W.H.O. (World Health Organization).

A few weeks ago, the Food and Drug Administration of the United States (F.D.A.) gave its approval for the commercialisation of Golden Rice. In an official letter addressed to the International Rice Research Institute, the developers of Golden Rice, the F.D.A. indicates that in their opinion this rice is safe for consumers (FDA, 2018). This endorsement is the third positive international evaluation for the biofortified and G.M. cultivation of Golden Rice. This year, Food Standards Australia New Zealand (Application A1138 – Food derived from Provitamin A Rice Line GR2E variation, 2018) and Health Canada (Novel Food Information – Provitamin A Biofortified Rice Event GR2E Golden Rice, 2018) also approved this crop. Needless to say, these three food safety agencies apply the highest and strictest quality and safety standards that exist worldwide, and their reputation is unquestionable.

In general terms, in 2016 the National Academy of Sciences, Engineering and Medicine of the U.S.A. presented a study that was considered the largest scientific review of G.M.O.s in the last thirty years. This study concluded that G.M.O.s are innocuous and, furthermore, many of the myths associated with them were discredited by its research findings (National Academies of Sciences, Engineering, & Medicine, 2016). The scientific report concluded that there is no evidence that these organisms have a negative impact on people's health. Quite the contrary, the work highlights the fact that transgenic crops can lead to a significant increase in improved global health and expressly cites the case of Golden Rice. No definitive evidence has been found that G.M.O.s cause environmental problems. According to the scientific report, the use of G.M.O.s does not reduce the diversity of plants or insects in the fields where they are planted and sometimes their use even increases them.

At European level, in 2010, the European Commission also published an extensive report exposing the safety of G.M.O.s, based on the research experience drawn from the dozens of projects supported in recent decades. 'The main conclusion to be drawn from the efforts of more than 130 research projects, spanning a period of more than 25 years of research, and involving more than 500 independent research groups, is that biotechnology, and in particular G.M.O.s, are not per se more risky than conventional plant breeding technologies, for example' (European Commission, 2010).

There is, however, a position that opposes to the development of G.M.O.s, aligning those who oppose the development of large-scale agriculture that uses G.M.O.s. This sector, mainly led by the organisation Greenpeace, warns of the multiple risks that underlie the use of techniques of biofortified agriculture.

They report health risks for the population, such as the appearance of new allergies, new toxins in food and the contamination of food due to greater use of chemical products, amongst others. They also warn of ecological dangers to the environment, such as soil pollution or the disappearance of species (mostly insects) and traditionally cultivated varieties. Finally, they mention the socioeconomic and agrarian risks as a possible dependence of the multinationals that own the G.M. seeds.

In short, facing these two opposing perspectives, it seems reasonable to offer a comprehensive and multidisciplinary vision that is responsible at a scientific,

economic, social and ethical level. It cannot be reduced to prejudices lacking scientific basis, or biased ideas from a political, economic or ideological point of view. This debate can bring hope and increase life expectancy of millions of people in the world.

Many regions in the world affected by hunger three decades ago will remain the same three decades later if nothing changes. If everything remains unchanged, the same populations condemned to famine, its derived diseases and even death will unfortunately remain unchanged. Given the lack of time and the urgency of the issue, demagoguery must be left aside.

As indicated by *Laudato si'* in the debate on the development of G.M.O.s,

‘Certainly, these issues require constant attention and a concern for their ethical implications. A broad, responsible scientific and social debate needs to take place, one capable of considering all the available information and of calling things by their name. It sometimes happens that complete information is not put on the table; a selection is made based on particular interests, be they politico-economic or ideological’ (Holy Father Francis, 2015).

While the debate continues, hunger and malnutrition are the main risks to global health (FAO, IFAD, UNICEF, WFP & WHO, 2017). Let us therefore pool our collective energies and resources to build capacity to rid humanity of these scourges.

### **2.3. International conference on poverty, hunger and emerging foods**

The Catholic University of Valencia San Vicente Mártir has led a group of 50 researchers and experts from different universities, who have joined their research efforts to search for novel solutions to the problem of world hunger and poverty.

As a result of the research work carried out by these experts, several international conferences were held that included the presence and keynote speeches of renowned scientists and experts, such as Sir Richard J. Roberts, Dr. Werner Arber, Dr. Ingo Potrikus, Dr. Marc Van Montagu and Jeffrey Sachs, amongst others.

At the International Conference on ‘Poverty, Hunger and Emerging Foods’, held in Valencia in October 2016, the result of the work carried out by the researchers and the presentations of the speakers with some very revealing final conclusions were presented (Sánchez García, 2018), which put forward a new vision on the problem of hunger.

The conference first established that human beings are responsible for the habitat of future generations and therefore it needs to be protected against man in the first place, against poverty and its direct consequence, hunger. Bearing this in mind, emphasis was placed on the need to focus the solution to the problem of world hunger and poverty from a sustainability perspective and the need to care for our common habitat, which is the world. A good way to do this is to take as a point of reference the integral ecology from its triple dimension: natural, social and human.

In this new approach to the integral eco-environment, close attention should be paid to the new global forms of poverty that arise (i.e., labour exploitation, forced prostitution and organ trafficking), which lead to situations of hunger and need.

Regarding the possibilities of applying technology to influence the process of improving foods and cultivated varieties, the participating experts explained that: ‘Nature uses cell recombination to search for solutions that improve all living beings.



In the specific case of man, he also uses his research capacity to improve the conditions of his life' (Sánchez García, 2018).

When extending the possibilities of using technology and biotechnological innovation in food production, specifically related to G.M. crops and biofortification mechanisms, the experts concluded that:

'Precision agriculture is a form of controlled cultivation that allows incorporating the process of cellular replication guided by human intelligence, through which crops are improved, new nutritional properties are incorporated to the food and the production is quantitatively and qualitatively improved food' (Sánchez García, 2018).

Concerning the biosecurity problem, the information on G.M. crops provided by the experts stated the following: 'Academies of medicine from around the world have assured that there is no scientific evidence of negative effects for humans in genetically modified foods (G.M.O.)' (Sánchez García, 2018).

On the other hand, the participating professors and experts recalled the relevant existing scientific consensus illustrated with the fact that: '119 Nobel Prize winners currently support an international campaign in favour of transgenic foods as a solution to the problem of hunger in the world, without prejudice to other forms of agriculture such as the traditional or ecological ones' (Sánchez García, 2018).

That remarkable scientific consensus has continued to expand, as seen in the II International Congress, which will be discussed later.

In this regard, the invention of Golden Rice has been one of the greatest discoveries in the field of G.M.O. research, and it has been presented as a great opportunity to nutritionally strengthen populations that are affected by certain diseases due to limited availability of food. However, decades after the invention of Golden Rice, the many obstacles and reticence surrounding this cultivation have prevented, to this day, a remarkable social impact.

It was also recognised that education should be a fundamental, transversal tool in the fight against hunger and poverty. It is perhaps the most powerful tool to fight the main problem of humanity from its foundations.

'Education has to take the importance of this human drama of hunger into account, thus incorporating both in schools and universities transversal guidelines that convey criteria of lucidity and prudence: lucidity to discern the urgent from the essential, without falling into consumerism, and prudence, to be able to, from austerity and sharing, lead a coherent life that recognises the dignity of every man' (Sánchez García, 2018).

The conference also highlighted that universities and research centres need to commit further to the problem of world hunger and poverty and the search for solutions that affect the different areas of the problem (food, health and biosecurity, economic, ecological, social and educational).

### **3. Hunger and sustainability**

#### ***3.1. Sustainability as an innovative key to rethink the problem of world hunger***

For years, the vertiginous flow of information and knowledge on the ecological situation of the planet we live on is increasingly discouraging. Most sources and climate



indicators seem to converge and point to a phenomenon of progressive deterioration of the world's ecosystems on a global scale, observable even at local level.

Given the evidence of the consolidation of this progressive deterioration of the conditions that life on our planet is developing in, humans are becoming aware that they need not only to verify this scientifically, but to refer to it and to debate it. This was probably always the case, but there is now a need to reflect on the problem and identify key points to use as a basis to propose viable solutions. Among the various options considered, sustainability has been established as a reference field that should guide the search for solutions.

Research into sustainability has therefore been configured as an accredited field of research, an unescapable reference for any rigorous analysis of long-term living conditions. This area of reflection, fostered by increased sustainability, is inseparable from an ethical perspective, as Parrilla Díaz rightly identified in her paper, *Ética y desarrollo sostenible: retos del desarrollo humano en el siglo XXI* (Parrilla Díaz, 2013), *Ethics and Sustainable Development: Challenges of Human Development in the 21st Century*:

'In my opinion, the current ecological crisis has deep ethical considerations because what is at stake now is the survival of the human species and non-human species; the future of current and future generations. It is about questioning human behaviours that endanger the safety and well-being of human groups around the world; they have the right to live in a healthy, peaceful environment that provides the necessary conditions for their development. And that the satisfaction of human needs cannot take place at the expense of deterioration and irreversible damage to the natural system that makes life on Earth possible' (Parrilla Díaz, 2013).

Sustainability has been consolidated, not only as a highly relevant field of technical research, but also as a whole horizon of reflection with an ethical component on human performance and its impact on the environment. From the observation of data, and the visible trace of human impact on ecosystems, the human being has sought references in his rationality that can be used to understand the problems and propose possible solutions.

The problem is that this reflection questioned human actions and decisions themselves, as well as development concepts. It meant self-questioning, which was demanded from external evidence, but which pointed to the very foundations and presuppositions of our development models, both in its theoretical formulations and in its praxis, which could not be as intelligent as it was supposed to be. Sustainability required rethinking many concepts and fundamental operating schemes that affected our models of economic and human development.

'The so-called Western model of development, in force in most industrialised countries, is based on the idea of unlimited economic growth. This model of civilisation, product of the Industrial Revolution of the 18th century, shows a utilitarian vision of nature where there are no limits to the exploitation of natural resources and economic progress is measured in terms of capital accumulation at the expense of damage environmental' (Parrilla Díaz, 2013).

Sustainability is indeed inseparable from a reflection on the performance of man as a moral subject, fully aware and responsible for his actions. Evading this ethical responsibility of human actions is irresponsible and doomed to failure. Sustainability

is linked to positivity, and every human being should opt for it. Not assuming the costs of an option does not mean that they do not exist, but that they are transferred or relegated. Sustainability is a human option, conscious and reflective, not evadable, since it is required and shaped by human rationality itself.

Sustainability has fostered a whole framework of analysis and understanding of environmental and social problems in their multifactorial complexity. This framework assumes that cooperation and coordination of efforts by governments, supranational organisations, public and private institutions, and the research community is necessary in order to analyse and propose solutions that improve life conditions on the planet, that allow human development and contribute to mitigating both environmental deterioration and the problem of poverty.

In the field of human nutrition, which tackles not only undernourishment but also malnutrition, lack of food and food insecurity, in a scenario of increasing population and growing demand, show that these solutions would achieve more productive and sustainable agriculture and livestock management methods. It is necessary to try to increase the production of food systems in order to meet the growing world demand, while conserving biodiversity and exploiting natural resources and ecosystems in a sustainable and respectful way. Food sustainability means establishing the necessary mechanisms that guarantee access to healthy, nutritious and adequate food for the whole current and future world population.

### **3.2. Ethics of sustainability or inertia (a discussion)**

Given the serious environmental and social problems faced nowadays, two basic approaches may be taken. One is inertia, which adopts the prevailing technocratic paradigm from postmodern immobilism and relegates the finding of solutions exclusively to the field of technology, particularly to technological innovation. It is a widespread attitude linked to evaluative relativism and a certain social disinterest in problems. Another position or approach, which, without ruling out this appeal of the innovative capacity of the human being, does not limit it to the technical field but seeks to identify new resources that can promote and mobilise the conscious and responsible action of the human being in all areas of human performance.

Techniques can provide great solutions in terms of new and sustainable food sources and emerging foods being researched and stemming from new cultivation procedures, such as those that are produced by precision agriculture, and new foods coming from G.M. transgenic crops. The visionary technologist Ray Kurzweil, educated at the Massachusetts Institute of Technology (M.I.T.), dedicates a section to the possible technical solution of world hunger through the cloning of animal tissue for the production of meat and proteins in his book *The Singularity is Near: When Humans Transcend Biology*:

‘Cloning technologies even offer a possible solution for world hunger: creating meat and other protein sources in a factory without animals by cloning animal muscle tissue. Benefits would include extremely low cost, avoidance of pesticides and hormones that occur in natural meat, greatly reduced environmental impact (compared to factory farming), improved nutritional profile, and no animal suffering. As with therapeutic cloning, we would not be creating the entire animal but rather directly producing the

desired animal parts or flesh. Essentially, all of the meat—billions of pounds of it—would be derived from a single animal’ (Kurzweil, 2005).

The M.I.T. engineer also addresses sustainability, considering both the environmental impact of the process as well as animals’ suffering. In terms of human beings, Kurzweil addresses economic and food safety aspects such as the elimination of pesticides and other hormones involved in traditional meat production systems, writing:

‘There are other benefits to this process besides ending hunger. By creating meat in this way, it becomes subject to the law of accelerating returns—the exponential improvements in price-performance of information-based technologies over time—and will thus become extremely inexpensive. Even though hunger in the world today is certainly exacerbated by political issues and conflicts, meat could become so inexpensive that it would have a profound effect on the affordability of food’ (Kurzweil, 2005).

The technologist addresses some aspects of the difficulties involved in overcoming the problem of world hunger in the current context, such as political and regulatory issues, and conflicts that affect the availability and distribution of food. After the materialisation of so many predictions made by Kurzweil that once seemed unrealistic, but that have ultimately been realised, including numerous developments and patents of his own, we are hesitant to question his projections regarding the possibility of meat production using new procedures. Mankind’s capacity for technical innovation is truly surprising, this visionary M.I.T. technologist thoroughly explained and, in part, demonstrated.

Considering all of this, given the challenge posed by the feasibility and sustainability of solutions in our time, taking the environmental and social impact of any measure into account, it does not seem appropriate to completely entrust the solution of problems and the re-conduction of the processes to a technical solution, which may not achieve it or be sufficient. It seems reasonable to appeal to the complete intelligence of man, and consequently, to the awareness and ethical responsibility of human beings in order to find valid and sustainable solutions.

As already stated about the perspective of our consideration:

‘Since some types of environmentalism exclude the human being in their consideration of the ecosystem, and if they do, they accommodate man in their approaches always as a variable that distorts and deteriorates the environment, we believe that a fundamental rethinking of the issue is needed, from the perspective of an integral environmentalism. The environmentalism we propose not only does not exclude the human being from this multifactorial equation, but also considers man as the fundamental, modifiable variable in that process’ (Sánchez García & Díez Sanz, 2018).

Man must undoubtedly be considered and included in the notion of ‘ecosystem’, firstly because he plays a very relevant part in the ecosystems that he participates in and, secondly, because the conscious and responsible action of human beings can be motivated, promoted and trained. Therefore, ethics, in this framework of comprehensive environmentalism, is a very relevant research vector that should not be ignored in the current debate on sustainability. Man should be aware that he can only live harmoniously with the environment and with himself if he chooses well. Man must assume new lifestyles that are more responsible to the environment, more austere styles that involve reducing, reusing and recycling available resources, and he must also be more responsible towards social and environmental problems.

Any redirection or reversal of the process of environmental deterioration involves assuming and implementing an ethics of sustainability based on a new environmental sensitivity, fundamentally ecological and social, which appears to be essential. Man is called to do good at all levels. Opting for good is never a mere accessory for the human being. Good is not just another option, since when man does not follow this ethical orientation implicit in his conscience, he and the environment that he lives in suffer the consequences. Ethics provide a final reference that must also be incorporated into the scientific and praxeological consideration of sustainability.

### **3.3. Conference on poverty, hunger and sustainability**

Achieving sustainability requires a human decision, assumed in a conscious, responsible way, guided by man's own rationality. It is necessary to establish a new model of development that is not limited to economic development, referenced to quantitative factors. A capacity development model should be promoted and implemented that incorporates parameters of basic health care services, such as health or education indicators, amongst others, which, according to this new development model, should be incorporated and universalised. Humanity must cooperate in the achievement of these goals, whatever our beliefs or personal approaches.

'We must seek the integral development of the whole person and of all people, to make possible, together, a new humanity in which poverty, hunger, exclusion, forced migrations and the violation of fundamental freedoms have no place' (Conclusions of the II International Conference Hunger, Poverty and Sustainability, 2017).

At this conference it was made clear that in this new development model man must occupy a central position, one that allows a human being to fully develop all his or her capabilities, physical, intellectual and spiritual. A new model of development based on sustainability, understood from an integral perspective, one that is not limited to an environmental matrix.

'We are called to an ethic of sustainability that places the most needy and vulnerable at the centre of this consideration, not only in our minds, but in our hearts, thus creating in us new lifestyles that are more austere, more creative and hopeful' (Conclusions of the II International Conference Hunger, Poverty and Sustainability, 2017).

In this regard, information and communication technologies and artistic disciplines can contribute to generating this new sensitivity that is necessary to create a new development model that also includes the most vulnerable people. And in the incubation of this new sensibility, ideological prejudices must be left aside.

'We, the developed countries, have the obligation to investigate all possibilities to alleviate hunger and poverty and make these new solutions available to all humanity, without ruling out viable options for ideological reasons' (Conclusions of the II International Conference Hunger, Poverty and Sustainability, 2017).

Moreover, this conference ultimately served to underline that broadly speaking G.M.O.s do not have any negative impact, as this could have been learned after decades of application in mass cultivation. However, studies conducted by the leading academics and research organisations have concluded that no harmful effects have been observed on either the environment or the health of people.

‘About precision agriculture and its fruit, i.e., genetically modified food, it has been scientifically proven not to pose risks to health or the ecosystem, since medical academies from around the world and almost 130 Nobel Prizes have recognised this. This agriculture must be put into practice because it has special relevance for areas of famine and poverty’ (Conclusions of the II International Conference Hunger, Poverty and Sustainability, 2017).

Finally, it should be added that the problem of food must be considered in all its dimensions, not only regarding malnutrition, but also undernourishment, lack of food and food insecurity. Biotechnological solutions applied to the production of food that do not entail risk to the health of people or damage to ecosystems should be implemented. All the capabilities of innovation and creativity of human beings must contribute to establish this sustainability option.

It is also important that religions collaborate and get involved in developing solutions to the problem of hunger and poverty, as the Catholic Church has done from a rationality point of view.

#### **4. Poverty, hunger and capacity development**

Poverty is a complex and multidimensional social phenomenon, and one can find different criteria to define it, based on different approaches. The most well-known approach focuses particularly on the economic dimension and the quantification of the problem. The summary of economic data presented by the World Bank on world poverty states that over 10% of the world population lives on incomes below U.S. \$1.9 per day (The World Bank, 2016).

In addition, the socioeconomic context of families remains decisive. On the one hand, disability affects poor families more significantly, especially children. People with disabilities suffer higher rates of poverty and are more at risk of poverty, meaning that people with disabilities are the most vulnerable among the poor (World Health Organization & The World Bank, 2011). And, among the former, children with disabilities are those who are at the greatest risk of poverty and social exclusion.

‘Many of the children with disabilities in the world are isolated and struggle against stigma, discrimination and a social environment that does not fit their needs or the realisation of their rights’ (UNICEF, 2017).

Poverty, as a social phenomenon and human drama, is not well defined, nor covered in its entirety from exclusively economic parameters, whether they are considered per capita income or per capita G.D.P.:

‘Poverty is not just an economic issue; it is a multidimensional phenomenon that includes the lack of income as well as the basic capabilities to live with dignity’ (The Human Rights Council, 2012).

Poverty is a multidimensional phenomenon that affects quality of life, preventing people from developing their lives in a manner consistent with the dignity of the human being. This has also been highlighted by other sciences, such as anthropology, sociology, philosophy or law:

‘Extreme poverty is characterised by multiple and interconnected violations of civil, political, economic, social and cultural rights and people living in poverty are

regularly exposed to denial of their dignity and equality' (The Human Rights Council, 2012)

The framework from which to approach this interconnection of factors cannot therefore be limited to the economic sphere but requires a broader reflection in conjunction with other disciplines that address other relevant dimensions of people development. As already stated, in this phenomenon and in our research into capacity development in the context of poverty:

'Economic data, of course, is undoubtedly relevant and useful, especially if we want to have some information about reality, but we need to connect those numbers with other dimensions of the human person, since, if we do not do it we will end up having a reductionist view of reality. Thus, we should not forget the specific human reality of those people who live in a world that excludes others, as this will negatively affect their life experience. It is necessary to remember, at this point, the difference between information and knowledge' (Sánchez García & Pérez Ruiz, 2017).

Data provides information on the phenomena. Knowledge is a logical connection or articulation of the data to make it meaningful. Knowledge establishes the relevance and meaning of this data by discovering connections in it that allow us not only to reference, but also to understand reality. It is therefore necessary to epistemologically distinguish between the operability of intelligence and the functionality of reason.

#### ***4.1. Intelligence and reason: the search for truth***

Information and knowledge are not interchangeable. Intelligence provides and processes data, but it is necessary to process it on another epistemological level, at a different logical level in order to determine its precise relevance and establish its significance, and this can only be done by using reason. As it has already been explained about this different epistemological functionality:

'Reason operates on the structure of sensitivity and the data provided by intelligence in order to apprehend reality in its connections. Reason allows us to grasp these data in their connection, connect them, and assemble them to make possible an understanding. Reason is, therefore, a superior capacity, a strictly human capacity that allows us to "apprehend reality in its connection"' (Sánchez García, Díez Sanz & Pérez Ruiz, 2017).

Rationality therefore assumes an apprehension of reality in its connection from the data provided by intelligence. Data cannot provide us with these keys of analysis and understanding of the phenomena because they are at another cognitive level. Using reason, man must identify the keys that enable human development.

#### ***4.2. Capacity development, key to getting out of poverty***

It is thus necessary to address the problem of poverty from the appropriate framework of capacity development, according to the dignity of the human person. Economic data are relevant and useful in order to quantify the phenomenon of hunger, to have relevant information about it. However, to address this issue in all its complexity, it is necessary to tackle the problem in connection with all the dimensions and aspects of human dignity.

In their research on human development, linked to human dignity and human rights, Sanz Ponce, Peris Cancio, and Escámez Sánchez (2018) compared two models of development: the prevailing one, based on economic growth (i.e., on G.D.P. per capita); and the capacity development model, based on the analysis of capacity development posed by Nussbaum. The three researchers have noted the limitations and insufficiency of the first model, an exclusively 'economic' model, as a criterion for evaluating human development, and have stated the need to extend or reconsider the second one, based on the development of capabilities. In their conclusions they state:

'Nussbaum's thought in her main works has been analysed and interpreted and we may conclude, considering the specific aims, that we sought that the model of development as growth of the gross domestic product (G.D.P.) is not a reliable criterion to measure the quality of life of each individual or the countries. It is insufficient, since it does not consider other fundamental elements such as health, education, equality in social rights, political participation in public affairs and solidarity with the disadvantages, both fellow nationals and immigrants, and with poor or developing countries (Sanz Ponce et al., 2018).

In order to fight poverty, it is necessary to establish a framework of appropriate analysis where it is necessary to specify what human development means, not limited to an economic dimension, but from a perspective that takes other social and welfare services into account, such as health care, education, equality of rights and opportunities, legal security, rights of political participation, etc.

### **4.3. Capacity development, key to getting out of poverty**

The need for this capacity development model is evident in the study of the relationship between poverty and disability, often omitted in development research. Martino and Barrera, in their research into this relationship, pointed out that 'poverty is a cause of disability' (Sanz Ponce et al., 2018). Poverty limits human development and creates conditions for the violation of human rights and social exclusion of people with disabilities.

Martínez Ríos demonstrated the relevance of this relationship and established some of the reasons for this omission:

'It is estimated that 15% of the world population has a disability. There is a direct link between poverty and disability. The population with disabilities is among the most disadvantaged and discriminated against. However, economic theories on development have omitted essential questions about this population, contributing to its invisibility and poverty' (Martínez Ríos, 2013).

From this perspective, Martínez Ríos stressed the need for a change of approach and the importance of adopting an approach based on the development of capabilities according to the rights of people:

'The theory of capabilities from a human rights-based approach provides us with a new dimension of development. The extraordinary costs derived from disability and the psychological, physical and social barriers faced by people with disabilities contribute to their poverty, lack of freedom and violation of human rights, and this is evidenced in the different studies being carried out. Cooperation for development becomes an essential tool for the promotion of the rights of persons with disabilities and the fight against poverty' (Martínez Ríos, 2013).



In our research into the relationship between poverty and disability, we already noted the difficulty of thinking about disability from parameters other than deficiency and limitation. For a long time, this has led to the marginalisation of these people or to them being treated differently from others, even in developed countries. This has been reflected even in the use of abusive language towards these people. Poverty only aggravates the situation of these people and leaves them at risk of exclusion and marginalisation, deprived of the assistance they need. In many developing countries, the institutional framework and care network of these countries do not guarantee prevention, diagnosis, or assistance to these people, to allow them to develop according to their limitations and capabilities.

Considering the fact that the governments opt for paying attention to disability by recognising human dignity, they reflect a commitment to inclusive development that is not included in economic development indicators, but affects peoples' quality of life, especially in the cases of the most vulnerable. This in itself is a particularly relevant indicator of development.

Education for development in sustainability, which should include education in skills, food education and personal austerity education regarding consumer habits and recycling in order to reduce environmental impact, should be incorporated via transversal guidelines in schools. In many developed countries, problems such as obesity, one of the so-called plagues of the twentieth century, even in its morbid state, stem from a lack of nutritional training and personal self-control, which are problems that can be educated and corrected by re-educating peoples' habits. It is particularly striking and contradictory that while 795 million people die in the world from hunger and undernourishment, according to F.A.O. data (FAO, IFAD, UNICEF, WFP, WHO 2017), 2.8 million people also die in the world due to obesity and being overweight, according to W.H.O. data (WHO, 2017). It is true that there is a lot of relevant and truthful information available, but training is not only about having information, but rather about developing capabilities to adopt healthy habits and then encouraging people to sustain them.

#### ***4.4. Moral education in face of the challenge posed by hunger and poverty***

Social and political institutions, as well as educational ones, must embrace these guidelines for the social implementation of sustainability. The institutional framework is a necessary and very relevant reference to address the challenge of hunger and poverty from this perspective, as Sapena and co-workers pointed out in their research into sustainable development: 'One crucial root to sustainable development and poverty eradication is strongly linked to the existence of inclusive institutions, and avoidance of extractive ones' (Sapena, Almenar, Apetrei, Escrivá, & Gil, 2018).

Economic growth does not translate directly into human development. We need to establish an appropriate institutional framework and the necessary social initiatives aimed at achieving it:

'Economic growth does not automatically translate to human development progress. Pro-poor policies and significant investments in people's capabilities-through a

detailed focus on education, nutrition and health, and employment skills-can expand access to decent work and provide for sustained progress' (Sapena et al., 2018).

Ethical reflection is a necessary reference within the scope of the current reflections on sustainability, which must be received and promoted by political, social and educational institutions. Education for development in sustainability, as it has already been described, must be incorporated in order to create new lifestyles which are socially and environmentally more responsible and more sustainable.

## 5. Research lines

### 5.1. Further research lines: biotechnology and biosecurity

There is an increasingly evident relationship between environmental problems, the exploitation of resources and social problems. This was reflected by the Council 'Justice and Peace', in its reflection into the problem of world hunger and the sustainability of the current systems of agricultural production:

'It is necessary to ask, even from an environmental point of view, about the level of sustainability of agriculture. That is, can the production of food continue, and in ever-increasing quantities, with current methods? What are the environmental "limits" that are found at the global level and at the local level? The facts that some natural resources are exploited beyond their rate of regeneration or that agriculture contributes in different ways to global emissions of greenhouse gases, for example, are very serious challenges to consider ...' (The Pontifical Council for Justice & Peace, 2016).

With this, the problem of hunger and farming systems and techniques connects with the environmental dimension and the sustainability of the ways to exploit the natural environment. A reflection on the limits of nature from a new approach is necessary, because natural resources are not infinite, and nature does not have an unlimited capacity for regeneration. It is a reflection with an ecological and economic dimension, but beyond the limits of strict instrumental rationality, because it also implies an ethical reflection. The right to enjoy existing natural assets does not legitimise an irresponsible exploitation of them from a mentality based on unlimited exploitation and depredation of resources.

In the context of the configuration of this necessary ethical reflection, the social teaching of the Catholic Church establishes the criterion of the common good as a basic reference that is unavoidable for the human being and the universal destiny of goods, the consideration that the planet's goods strictly belong to all human beings and that people are administrators of them. Undoubtedly, both principles help to establish a valid criterion that we believe can help to shape this ethics of sustainability.

In the field of this ethical reflection on the availability of natural resources in relation to the problem of poverty and world hunger, Marc Van Montagu stated:

'The shame of poverty and hunger seems to leave many of us indifferent. I wonder if it is due to our resilience to hardship, which is sometimes necessary, yet other times can mislead us. The eradication of this plague will require a fundamental shift in the way we perceive the world and our place in it. Rationality tells us that the whole of humanity should be able to share equally the economic, social and cultural benefits of our natural resources' (Van Montagu, 2018).

Research into biotechnology applied to agriculture represents an option with great potential to solve the problem of world hunger, a field of research that is not only relevant for the future but for the present as well, one that is fully compatible with this ethics of sustainability.

The implementation of new biotechnology techniques in agriculture, such as G.M.O.s, can be a potential way to help fight world hunger, especially in those regions where there are specific difficulties, whether due to the type of crops being produced or because it is not possible to grow.

Generating more efficient crops by using resources, crops that are more resistant to weather conditions and pests, more productive crops in terms of the products they yield, etc. may be a good opportunity to produce food that contributes to improving the situation of people who, at the moment and using traditional methods, cannot satisfy their nutritional needs.

Why is it so important to find solutions in agriculture? As Richard John Roberts explained, 'food means agriculture' (Roberts, 2018). Although it is a process that began 12,000 years ago, agriculture continues to represent today's main source of human nutrition. Since its inception, the process of selection and improvement of varieties and development of appropriate cultivation techniques has not stopped, right up until the latest developments, G.M. crops, that Roberts referred to with the following:

'All serious scientific studies, i.e., those published in prestigious journals, show that the plant varieties prepared by G.M methods are not more dangerous than those available by traditional breeding techniques. If anything, the G.M.O. varieties are likely to be safer than traditionally bred varieties because they are subject to many more controls' (Roberts, 2018).

Consumers in developed countries can always choose between foods from traditional, organic, or transgenic agriculture. Their purchasing power in terms of per capita income and the availability of options in developed markets will always allow them to choose. However, at the same time, there are human beings dying of hunger, and there seems to be no justified reasons, at least scientifically, for that exclusion of biotechnology solutions.

'The Nobel Laureates Campaign was initiated to express a respect for science, to insist that non-scientific statements be withdrawn and to make sure that one of the most promising technologies, the G.M.O. method would be available for the benefit of the developing world' (Roberts, 2018).

This increasingly broad and relevant outstanding scientific consensus cannot be overlooked or ignored, neither by the scientific community, nor by society. However, the biased information disseminated by some environmental groups has a wide resonance in the media, which affects and conditions public opinion significantly.

While writing these lines, it has come to our attention that the German multinational Bayer successfully completed the purchase of the American firm Monsanto. One of the first decisions made in this purchase process is that Bayer decided to delete the name Monsanto, bringing years of poor corporate image and this was at the centre of many criticisms and attacks, mostly from the environmental groups opposing to the development of G.M.O.s. This does not mean that the products

marketed by Monsanto will disappear from the market. On the contrary, most will continue to be marketed under the Bayer brand.

This purchase implies the setting up of the largest corporation in the agrochemical sector world-wide, in a process that has been endorsed subject to conditions of both the European Commission (European Commission, 2018) and the Antitrust Division of the Department of Justice of the United States (U.S. District Court for the District of Columbia, 2018).

And, although Bayer's CEO stated: 'We want to help farmers across the world grow more nutritious food in a more sustainable way' (BAYER, 2018), and we absolutely share this purpose, we understand that the great work in the marketing of G.M. crops is to ensure that the seeds are in as many hands as possible. It would not be fair to have only a few people controlling all the production and worldwide distribution of elements that should be at the disposal of everyone in the world. These should first and foremost aim to improve the situation of regions affected by hunger and malnutrition.

Parallel to the practical application of new modes of food production, such as those offered by the biofortified agriculture of G.M.O.s, a regulatory and supervisory context must be developed in order to guarantee a secure and stable framework for the risks related to agriculture and livestock production. That is, along with the practical application of biotechnology, biosecurity should be given as a requirement to reduce, and even avoid, the potential risks posed exist both to human health and to crops and livestock.

For years, biosecurity has emerged as one of the most pressing issues, as safeguarding the safety of consumers and producers is a priority, as is the control of potentially adverse effects and unwanted changes, such as alterations in the ecosystems or the uncontrolled spread of diseases. This is a very complex issue that requires a comprehensive and harmonised vision by all sectors, organisations and institutions involved.

'It is clear that the complexity of biosafety issues requires careful formulation of problems and close collaboration of interdisciplinary scientists and risk assessors with government agencies, N.G.O.s and the public, in order to estimate cross-sectoral risks for biosecurity' (FAO, 2017).

Additionally, a further challenge is posed in the development of biosecurity both in developing and underdeveloped countries, which have very few resources to implement the new regulations and recommendations:

'Achieving better biosecurity outcomes in an effective and cost-effective manner, especially in countries in transition and in development, is a major challenge' (FAO, 2017).

## **5.2. Genetic edition through C.R.I.S.P.R./Cas9**

Another tool that could offer an opportunity to beat world hunger, along with biotechnology and the development of G.M.O.s, is genetic editing, such as the clustered regularly interspaced short palindromic repeats (C.R.I.S.P.R.) technology.

Since its discovery in 2012, the C.R.I.S.P.R./Cas9 technology has meant a qualitative leap in genetic editing (Jinek et al., 2012). Through this technology, completely

specific modifications of the genome can be made with a high degree of efficiency and specificity (Carroll, 2014). This can be applied to the development of agricultural and livestock applications, and the diagnosis of diseases (Cyranoski, 2016), even for genetic modification of the human germ line (Gómez Tatay, 2015).

In terms of agricultural applications, recently, the research group 'Ionic transport in cereals and adaptation to the environment' of the Biochimie et Physiologie Moleculaire des Plantes Joint Research Unit (Université Montpellier II, C.N.R.S., I.N.R.A. et Montpellier SupAgro), has attained a research achievement that should be reviewed. This group studies the role of transporters and ion channels in the mineral nutrition of plants, taking rice as model cereal, and its adaptation to the abiotic limitations in connection with the Fukushima accident (teams of Japanese researchers and C.E.A. also collaborate). Using the C.R.I.S.P.R./Cas9 system, they have developed a variety of rice that is capable of not selectively absorbing the caesium from the earth and that this radioactive substance does not contaminate the edible parts of the plant (Nieves-Cordones, 2017; Nieves-Cordones et al., 2017).

Undoubtedly, this finding offers a promising opportunity to recover the enormous cultivation areas that are currently unproductive due to the radioactive contamination of the soil, as a consequence of the nuclear accidents of Fukushima or Chernobyl. This variety of rice developed by researchers from the Montpellier group may be applied in crops of contaminated areas so that their productions are suitable for food use.

In this way, the C.R.I.S.P.R. genetic edition could be used to tackle agricultural problems that are as complex as the ones just mentioned.

In conclusion, it should be noted that this is a completely revolutionary technique that could generate very significant advances in various fields, and given its multiple possible applications, the development of C.R.I.S.P.R./Cas9 also involves a series of risks, which are fundamentally biomedical, environmental, and ethical. These should be handled with absolute care (Gómez Tatay, 2015).

Its application in the cultivation of plants and livestock production intended for human consumption still requires intense development efforts, that at one time would allow it to reach a regulation in its application that would be acceptable and safe (Carroll, 2014). Its application in other areas, such as the modification of the human germ line could have consequences that are still unpredictable today. Therefore, the application areas of this new genetic publishing technology should be closely monitored and, above all, they should be at the service of the common good of humanity.

### **5.3. Phytobiome**

Another potential tool aimed at improving the production of food designed to meet the needs of the populations living in areas affected by hunger is the phytobiome. As stated throughout this paper, it is foreseeable that if no significant changes are made in agriculture, agriculture will not be able to produce enough food to feed and fully satisfy the nutritional needs of the entire world's population.

After the development of G.M.O.s and genetic editing using the C.R.I.S.P.R./Cas9 technique, now let's consider research examining new ways to use the modifications in the phytobiome of some plants (Broadfoot, 2018).

Currently, seeds are being marketed that are able to protect themselves, for example, against the threats posed by some pests, a fact that exponentially increases their productivity. Among the most remarkable findings, particular mention can be made of the seeds that have been modified by a cover that protects them by generating a barrier against pests, thus reinforcing the immune system of certain plants.

Probably, these actions in the phytobiome plant are less controversial than those presented by G.M.O.s. However, they are not exempt from risks (Broadfoot, 2018). Any significant progress in biotechnology applied to achieve a more precise, efficient and productive agriculture must be executed according to a maximum safety and responsibility criteria.

#### **5.4. Research in the field of moral education**

Current educational structures, methods and curricula should be further explored to aid in the training and exchange of intelligence and motivate rationality, thus making it possible to develop capabilities, especially in countries with lower levels of development, in order to foster innovation. In addition, it is necessary to continue working on pedagogical lines so that children and young people all over the world, especially in the most underdeveloped places, can find a way to solve their problems and progress in life.

The capacity-building approach should not forget human dignity, and the human rights mentioned in the present work. New lines of research in education must be developed in order to form vectors and guidelines that can be incorporated into educational programmes as transversal orientations, contemplating all the aspects that this orientation supposes, to make education in sustainability a reality.

These programmes must include education in capabilities, acceptance of our neighbours and non-discrimination of people, training for care and accompaniment in disability, education in healthy eating habits, environmental and social awareness, guidelines for the promotion of solidarity, education in personal austerity to acquire sustainable habits that reduce the environmental impact. These are some of the main aspects that this social education programme should have for sustainability.

## **6. Conclusions**

The problem of world hunger is one of the most significant problems facing humanity. Providing solutions to a dramatic situation that affects so many millions of people around the globe cannot be left to chance, but rather depends on joint, interdisciplinary efforts, and on the union between the scientific community and public authorities.

Undoubtedly, it is our responsibility to find solutions, and for this, science must be put at the disposal of man, and particularly at the disposal of the neediest. The advances being achieved in the field of biofortified agriculture provide a forward-looking scenario, which should continue to be further developed in the coming years. Every opportunity must be scientifically and ethically studied and analysed.

Both G.M.O.s and the C.R.I.S.P.R./Cas9 genetic edition applied to crops or modifications on the phytobiome of certain plants can open new ways to solve a problem that weighs on the future of humanity. Therefore, a serious, broad and responsible debate must be opened, one that considers all the scientific and ethical aspects involved.

Sustainability is inseparable from an ethical reflection on the performance of man as a moral subject, a subject that is fully aware and responsible for his actions. Evading this ethical responsibility of human actions is an irresponsible and doomed to failure. Sustainability is linked to opting for good, an option that every human being chooses.

It is necessary to address the problem of poverty from the appropriate framework of capacity development according to dignity of the person and human rights that is currently being developed. Economic growth does not directly lead to human development, it is necessary to establish an appropriate institutional framework and social initiatives aimed at achieving this.

Sustainability in food assumes that the mechanisms that guarantee that the whole world's current and future population can access healthy, nutritious and adequate food should be established. There seems to be no justified reasons, at least scientifically, for the exclusion of biotechnological solutions. There is a relevant scientific and increasingly extensive consensus, which cannot be omitted or ignored by society. Consumers in developed countries can always choose between buying foods from traditional, organic or transgenic agriculture (G.M.O.), but while we do have this choice, at the same time there are thousands of human beings dying of hunger.

Poverty is a cause of disability by limiting human development and creating conditions for the violation of human rights and social exclusion of people with disabilities. As governments opt to pay attention to disability, by recognising the dignity of people, they reflect a commitment to inclusive development that affects the quality of life of people, especially the most vulnerable.

Education in sustainable development, which must include education in skills, food education and education in personal austerity regarding consumption and recycling habits to reduce environmental impact, must be incorporated as transversal competences and guidelines in all school plans. It is particularly striking and incongruous that while 815 million people die from undernourishment and malnutrition in the world, according to F.A.O. data (FAO, 2017), 2.8 million people also die due to obesity and being overweight, according to W.H.O. data. Training is not merely about providing information but involves developing the necessary skills to adopt healthy habits and encouraging people to sustain them. All political, social and educational institutions must accept these guidelines for the social implementation of sustainability.

Finally, it should be emphasised that continuing to develop appropriate lines of research in the field of biotechnology and food biosecurity is a priority, analysing the developments and applications of the C.R.I.S.P.R./Cas9 molecular technology and the possibilities of exploitation and application of phytobiome. It is also convenient to continue offering an approach based on the development of capabilities and new lines of research in education in order to create vectors and guidelines that are



incorporated into programmes and educational centres as transversal guidelines in order to be able to make sustainability a social reality.

Among the possible implications for professionals in this work, we can highlight:

For economists: not basing development metrics on exclusively economic parameters, gauged in terms of GDP or income, but rather on broader criteria, such as environmental impact, social integration and human capacity development.

For ecologists: the consideration of a comprehensive ecology that also incorporates the human being into the concept of ecosystems and the multifactorial equation of development in which economic, environmental and social variables converge.

For agri-food professionals and researchers: considering the relevance of the ethics of sustainability as a means toward the good that should be incorporated into and evaluated in all technical developments, and not referring to biosecurity, but also to complex environmental and social interactions, with all their implications.

For those responsible for educational curricula, teachers and educators: the advisability of incorporating cross-cutting guidelines for the promotion of more conscious, sustainable and responsible habits. These include practices to reduce, reuse and recycle scarce resources, and attention to the development of man's capabilities, in all their dimensions.

For politicians and public officials: the importance of organising inclusive scientific, technical and ethical committees, to seek advice and adequately assess the implications of all alternatives and solutions currently available, and those that will arise in the near future, with a view to all their economic, environmental and social repercussions. In parallel, and no less importantly, the generation of new and inclusive institutional frameworks that allow and encourage more effective social action in the fight against poverty and exclusion of the most vulnerable.

## 7. Results

The conclusions reached during this investigation are as follows:

- The problem of world hunger, rooted in the problem of poverty, requires an analysis into a new framework of consideration, influenced by environmental and social sustainability, which we consider as integral as ethical reflection.
- New scientific and technical developments open up a wide spectrum of new solutions. Evaluation featuring integrative consideration, both technical and ethical, of each one of the scientific innovations and specific solutions that can constitute important advances towards the solution of this problem is necessary.
- It is necessary to continue pursuing lines of research into new developments: research into biotechnology applied to agriculture represents an option with great potential to solve the problem of world hunger.
- A more extensive and thorough social and scientific debate is needed on the possibilities and risks of GM foods and G.M. crops, addressing all the perspectives on the issue, without disregarding the economic and agricultural interests that are also involved, as well as the legislation governing these crops.

- Phytobiomes offer a potential plethora of new developments and tools for the management of agricultural systems, making clean production possible, in line with the new environmental demands of consumers, and the agro-industry itself, which must be evaluated.
- The applications of C.R.I.S.P.R./Cas9 molecular technology must be analysed, with a view not only to the unquestionable genetic potential of this tool, but also from an ethical perspective, addressing the risks inherent to its genetic impact when creating extensive mutations.
- Education for sustainable development should be incorporated into educational programmes, offering different subjects with more transversal orientations.
- New and inclusive institutional frameworks that make possible and promote more effective social action in the fight against hunger, poverty and the exclusion of the most vulnerable should be promoted.

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