BIOTECH FOOD, THE SOLUTION TO WORLD HUNGER?

A Socio-ethical Consideration on the Introduction of Genetically Modified Organisms (GMOs) to Agriculture

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Have we finally found the solution to the global problem of hunger? It is with great optimism that the introduction of genetically modified organisms (GMOs) to agriculture is being proposed as the answer to world hunger. Yet this proposition has been under serious criticism and the production of GM crops and food has become a contentious issue especially in the field of agriculture, economics and ethics. The debate has touched on many concerns related to health, ecology, biodiversity, genetic integrity, food security, sustainability, international trade and global economy. Examined from the scientific, economic, political, cultural and ethical perspectives, the issue has caused a divide among intellectuals, scientists, ethicists and farmers. With the moral dimension taking prominence, the proponents of both camps, pro-GMOs and anti-GMOs, appeal to ethical reasoning in order to argue for what each believes to be for the common good of humanity. The Catholic Church, in her poignant claim to moral authority and guidance, does not speak in unison regarding this recent ethical challenge.[1] Reflection and discernment are still underway as to the real benefits

[1] It was reported that the Catholic Bishops' Conference of the Philippines has urged the government to postpone the authorization of GM corn. The same report said that the position of the Philippine clergy has caused some concerns to the GM supporters in the Vatican. See John Hooper and John Vidal, "Vatican Backing of GM Crops Sparks Church Row," *The Guardian-UK,* 14 August 2003. http://www.rense.com/general40/gmm.htm (access: 24/8/03). See a report on the stance of the Southern African Catholic Bishops' Conference against genetic engineering in agriculture: "Catholic Church Calls for a Moratorium on Genetically Engineered Foods and Crops," Pretoria, November 2000. http://www.ncric.com/SACBC-Statement.html (access: 24/8/03). Opposition against GMOs is not wanting in the North. See Harvey Shepherd, "Seeds of Discontent: Canada's Catholic Church is concerned that agribusiness is taking control of genetically modified crops at the cost of poor farmers around the world," *Montreal Gazette*, 30 November 2002. http://www.nerage.org/stories.php?story=02/12/01/0380011 (access: 24/8/03).

or dangers of the new technology. Is the introduction of GMOs the solution to world hunger and poverty? Or will it wreak more havoc to human health and the environment pushing the weak and the poor further into misery and dehumanization?

This paper aims to make a humble contribution toward a deeper socio-ethical consideration on the issue of green or agricultural biotechnology. At the outset, we recognize that we cannot claim neutrality regarding this issue. It is from the perspective of those in the margins, in the Two-Thirds World, that we wish to articulate our position. Without dismissing the arguments forwarded by those who support green biotechnology, we have made efforts to give greater attention and sensitivity to the dissenting voices and indignation of the farmers as well as organizations that represent them. Our reflection will have four main parts. It will, first, present, against the background of the problem of food security, the contentious claim that green biotechnology is the solution to world hunger. The second part will contest such assumption from the perspective of political economy, understanding the issue of food security and sovereignty along a different socio-analytical framework of globalization. Part three will expound on some critical issues related to the impact of GMOs to human health and the environment. The fourth part will examine the ethical perspectives and presuppositions that are employed in the argumentation. A short conclusion will wrap up the discussion and will underline some important considerations about the debate.

Agricultural Biotechnology: Proposed Solution to World Hunger

Recent statistics hold that there are more than 2.5 - 3 billion people all over the world now living in severe poverty, surviving on less than two dollars a day.[2] The frequency of reports about people's starvation because of famine, drought or economic collapse only trigger sympathy or pity but

[2] See World Bank Staff, *World Development Report 2003: Sustainable Development in a Dynamic World: Transforming Institutions, Growth and Quality of Life* (Washington D.C.: World Bank Publications, 2002), ix.

not shock or surprise.[3] Economic technocrats refer to the traditional Malthusian formula as the main reason for this tragic reality.[4] Thomas Robert Malthus (1766-1864), an English economist-sociologist, theorized that poverty is inevitable because population tends to increase in geometrical ratio while food does so only in arithmetical ratio.[5] In 1999, United Nations demographers reported that the world's population had doubled from three billion in less than 50 years. They project that it will reach nine billion in the next 50 years.[6] The symbolic identification of the six billionth child born in Sarajevo was meant to communicate the challenge of feeding the world's hungry population. There are fears that the earth may no longer be able to feed, clothe and provide other basic necessities of life for humanity's growing numbers. Several international conventions have taken notice of this concern and have made resolutions that no individual would go hungry in the future.[7] The World Food Summits (WFS), organized in Rome in 1996 by the United Nations Food and Agriculture Organization (UN-FAO), echoed the same commitment of achieving food security. Such commitment is based on its ethical assumption that access to food is a universal human right.[8] The UN Millennium Declaration adopted in September 2000

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[3] To cite some examples of reports, see Penny Dale, "Ethiopian Hunger Could be Sidelined by Southern African Famine, Groups Warn," *One World*, 06 August 2002; Catholic Relief Services, "Humanitarian Organizations Launch Global Campaign to Avert Famine in Africa," *Catholic Relief Services*, 3 December 2002. http://www.globalpolicy.igc.org/ngos/aid/2002/1203africa.htm (access: 23/9/03).

[4] Ross speaks of how the Malthusian theory persists as a common explanation to poverty, death and environmental degradation despite formidable and compelling criticism. See Eric B. Ross, *The Malthus Factor: Poverty, Politics and Population in Capitalist Development* (London: Zed Books, 1998).

[5] Thomas Robert Malthus, *An Essay on the Principle of Population, as it affects the Future Improvement of Society* (1798, revised ed, 1803, reprinted, *inter alia,* by the University of Michigan Press, 1959, and the Modern Library, 1960). He spoke of two principal ways of controlling population increase: first, preventive checks (self-restraint, vice and birth control) and second, positive checks (famine, misery, plague, wars). The failure of the first will be corrected by the second.

[6] See Report of United Nations, Population Division, Department of Economic and Social Affairs, "World Population 2002," http://www.un.org/esa/population/publications/wpp2002/WorldPop2002.PDF (access: 20/9/03).

[7] During the World Food Conference in Rome in 1974, then US Secretary of State Henry Kissinger made a pledge: "By 1984, no man, woman, or child would go to bed hungry." See Lester R. Brown, "Eradicating Hunger: A Growing Challenge," in *State of the World 2001: A Worldwatch Institute Report on Progress Toward a Sustainable Society*, 43.

[8] See Food and Agriculture Organization of the United Nations, *Ethical Issues on Food and Agriculture*, FAO Ethics Series (Rome: FAO, 2001), 4.

speaks of reducing by half extreme poverty by 2015,[9] an unethically limited target that fails even in its own terms and measures of realization.[10]

The Green Revolution

During the past several decades, attempts have been made to address the challenge of the Malthusian equation. On one side, there have been worldwide aggressive campaigns and programs to contain population explosion especially in the Two-Thirds World through legislations on birth limitation and through the introduction of contraceptive thinking, methods and mechanisms. These efforts have had a dramatic impact on the demographic rates in many countries of the globe. On the other hand, interventions have been made in increasing food production. Scientific research and experiments have been conducted to take a closer look at the perennial problems in agriculture as they relate to farming, storage, transport and marketing of food products. Inventive solutions have been proposed in order to address the identified concerns. The production and introduction of new farm aids, like chemical pesticides, fertilizers, and hybrid seeds were among the technologies offered for better agricultural output. The so-called 'Green Revolution', which started from the wheat-development research project of an American agronomist, Norman Ernest Borlaug (1914-) and flourished in the 60s through the 80s, ensured higher yield of farm products. The Masagana 99[11] made the Philippines an important model and research center of agricultural development in the region, especially through the International Rice Research Institute (IRRI). Yet, the 'miracle' was short-lived as negative consequences began to manifest. "Chemical pesticides,

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[9] See Charis Gresser and Bruce Ross-Larson, eds., *Human Development Report 2003: Millennium Development Goals: A Compact Among Nations to End Human Poverty* (New York: United Nations Development Programme; Oxford: Oxford University Press, 2003), 1.

[10] An alternative World Food Summit that was organized on 10-13 June 2002 in Rome by social movements, farmers, fisherfolk, NGOs, peoples' organizations, trade unions, etc. expressed disillusionment and rejection of the official declaration of the UN-organized WFS in 1996. See NGO/CSO Forum, "Food Sovereignty: Right for All," http://www.foodfirst.org/progs/global/food/finaldeclaration.html (access: 17/10/03).

[11] Unified Rice Application Research Training Information Program, *16 Steps Masagana 99 Rice Culture: Transplanted, Irrigated and Rainfed Lowland Ricefield* (Diliman, Quezon City: Bureau of Agricultural Extension, rev. ed. 1985 [1982]).

fertilizers and hybrid seeds have destroyed wildlife and crop diversity, poisoned people and ruined the soil."[12] Alarming figures of some earlier reports claimed that "[i]t has been estimated that 375,000 Third World peasants become ill every year from pesticide, and that 10,000 die."[13] Due to the degradation of soil, a decline in harvest was observed after reaching a plateau of high productivity. Consequently, farmers are left buried in debt as returns of harvest do not measure up to very high production costs. Furthermore, Martinez, referring to the trade-off between quantity and quality of harvest, describes this tragedy of Green Revolution as a period of "feast and famine". She argues that due to monocultures of selected crops (wheat, rice, and corn), "the availability of and access to micronutrient rich food crops actually decreased for millions of poor people."[14] In summary therefore, it has been argued that "the Green Revolution, which, despite the hype about feeding the world, has actually left many people poorer and hungrier than in the past."[15] Such unhappy conclusion of the narrative of Green Revolution program paved the way to 'Gene Revolution', a blurb for more sophisticated scientific method of biotechnology, i.e., genetic engineering or modification of crops.

The Gene Revolution

The science of genetics could be traced back to Charles Darwin (1809-1882) who developed his theory of evolution in his monumental work, *On the Origin of Species by Means of Natural Selection* (1859). But it was his less known contemporary, the Austrian monk botanist, Gregor Mendel

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[12] See Nicholas Parrott and Terry Marsden, *The Real Green Revolution: Organic and Agroecological Farming in the South* (London: Greenpeace Environmental Trust, 2002), 4.

[13] See Upendra Baxi and Clarence Dias, "Preservation and Access to Plant Genetic Resources," *IDOC Internationale* XVI, 2 (1985): 6.

[14] She took notice of the significant and consistent decline of green-leafy and yellow vegetable consumption in the Philippines. Anna-Rosa Martinez, "Engineering Solutions to Malnutrition," in Kristina Plenderleith and Pieter de Meyer, eds., *Sustainable Agriculture in the New Millennium: The Impact of Biotechnology on Developing Countries, Conference Proceedings* (Brussels, European Union, 2000), 72.

[15] Genetic Resources Action International (GRAIN), "Against the Grain," March 2000, http://www.grain.org/publications/reports/grain.htm, cited in Per Pinstrup-Andersen and Marc J. Cohen, "Biotechnology and the CGIAR," in *Sustainable Agriculture in the New Millennium*, 60.

(1822-1884), who more specifically made the pioneering studies on genetics that resulted to his theory of heredity. Mendel published his work on inheritance patterns in peas in 1865, yet it was only in the beginning of the 20th century when studies on genes became more pronounced. Human manipulation of genes began to be considered as a possibility when Herman Joseph Muller (1890-1966) and Lewis John Stadler (1896-1954) discovered in 1920s that radiation could induce mutations in plants and animals. The 1930s and 1940s saw the emergence of new methods of chromosome and gene manipulation by using techniques such as tissue culture and embryo rescue for new hybrids. And in 1953, the scientific community rejoiced over the solution of a fundamental problem on the science of genetics when James Watson and Francis Crick discovered the double-helix structure of the DNA (Deoxyribose Nucleic Acid), the chemical substance of heredity. The breaking of the genetic code of the so-called 'blueprint' of life ushered in further breakthroughs in molecular biology. More scientific researches and experimentations on plant genome through techniques of gene splicing and recombination opened up possibilities for the genetic transformation of plants by introducing desired qualities derived from the genes of other living organisms.[16] Hepher and others describe in scientific terms what they consider as advantages of new techniques in producing new varieties of plant species:

> Genetic transformation via pollen vectors has several advantages in the generation of new crop varieties over both conventional plant breeding and more novel techniques such as the use of plasmid vectors. Apart from DNA extraction, manipulation and injection, it follows standard plant breeding methodology. However only one or a few genes may be transferred, so reducing the number of plant generations required to stabilize the new variety, and sterility barriers may be overcome, permitting inter-generic gene transfer. In contrast to plasmid vectors the need for embryo culture or regeneration of plants from callus is eliminated and montyledonous

[16] Asexual combination of two different lines/species through protoplast fusion (transfer of only a few chromosomes or even smaller nuclear genetic units) has superseded conventional plant breeding of somatic hybrids (where complete genomes of two fusion parts are combined). See O. Schlieder, "Genetic Manipulation by Protoplast Fusion," in *Genetic Engineering of Plants and Microorganism: Important for Agriculture*, eds., E. Magnieni, D. de Nettancourt et al. (Dordrect, Boston, Lancaster: Martinus Nijhoff, 1985), 26-27.

> plants are not excluded. Additionally many valuable agronomic traits such as yield and stress resistance are probably controlled by gene complexes which may be 'scattered' over the genome; problem mediated transformation using subsets of total nuclear DNA may be a possible approach to this problem.[17]

In practical terms, Prakash speaks of the wonders of such technology, "the new genetic enhancement tools allow scientists to redesign crop plants to be more productive, more sturdy, tolerant to diseases and pest, and with improved nutritional attributes such as enriched protein quality and enhanced vitamins."[18] We can add to this list Sandalow's appreciation of the claimed benefits of biotechnology: "reduced need for chemical and water inputs, increased resistance to crop stress such as drought; smaller losses from spoilage and longer shelf lives; increased generation and rural development, medicines and vaccines that are more affordable and accessible."[19]

With a series of crop field trials since 1986,[20] transgenic crops (like corn, cotton, oilseed rape, potato, soya, tomato, sugar beet and tobacco, among others) with traits that include herbicide tolerance, insect resistance, virus and other disease resistance and the other genetic applications (altered starch/sugar combination; altered oil composition and plant fertility control mechanisms), have been increasingly used in more countries. In the year 2000, it was estimated that 44.2 to 109.2 million hectares of farmlands worldwide are given to the cultivation of transgenic crops, especially in four main countries, with the United States leading the race.[21] In the Philippines, the biotechnology program began in 1980 with the establishment of

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[17] A. Hepher, P. Gates and D. Boulter, "Microinjection of DNA into Pollen, Ovaries and Somatic Cells," in *Genetic Engineering of Plants and Microorganism*, 32.

[18] C. S. Prakash, "Feeding A World of Six Billion," *AgBioForum* 2 (3 & 4) 1999: 223-225. http://www.agbioforum.org/v2n34/v2n34a13-prakash.htm, (access: 12/01/2004).

[19] David Sandalow, "Report to Subcommittee on International Economic Policy, Export and Trade Promotion Committee on Foreign Relations United States Senate," http://usinfor.state.gov./topical/global/biotech/00071301.htm, (access: 20/8/03).

[20] See Clive James, *Global Status of Transgenic Crops in 1997* (New York: International Service for the Acquisition of Agro-biotech Applications, 1997), v.

[21] According to the 2000 statistics, U.S. has 33.3 million hectares (68%); Argentina, with 10 million hectares (23%); Canada, with 3 million hectares (7%); China, with 0.5 million hectares (1%). See Clive James, "Global Review of Commercialized Transgenic Crops: 2000," in *International Service for the Acquisition of Agri-biotech Applications (ISAAA) Briefs* 21-2000. http://home.intekom.com/tm_info/rw10104.htm#14 (access: 27/10/03).

the National Institute of Molecular Biology and Biotechnology. Yet it was only in 1997 through the Agriculture Fisheries Modernization Act (AFMA) that a substantial increase in budget (from US $ 1 million to US $ 20 million per year) has intensified research and application of biotechnology in agriculture toward a wider commercialization of the GM products in the local market.[22]

It has been argued that these agro-biotech applications have resulted in huge benefits of savings and income in millions of US dollars as a result of better yields and handling of agricultural products. No wonder why multinational agribusiness corporations like Monsanto, Bayer, Florigene, Syngenta, Delta and Pine, AgrEvo, Novartis and Pioneer Hi-Bred, among others, make big investments in the development, production, commercialization and promotion of GMOs. "Although a chemical corporation may spend as much as $ 500 … developing a popular patented substance, in a few years time, will produce the annual revenues that may run as high as 500 million to $1 billion."[23]

With the above assertion of the potentials and benefits of GMOs, agri-biotech applications have been more and more aggressively endorsed to take over traditional and conventional farming and agriculture. Many institutes of research and learning as well as big international organization like the Consultative Group on International Agricultural Research (CGIAR),[24] Food and Agriculture Organization of the United Nations (UN-FAO) and the International Fund for Agricultural Development (IFAD) want to go

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[22] See Reynaldo de la Cruz, "Philippines: Challenges, Opportunities, and Constraints on Biological Biotechnology," in *Agricultural Biotechnology and the Poor: An International Conference on Biotechnology,* eds., J. G. Persley and M.M. Lantin (Washington DC: CGIAR and US Academy of Sciences, 1999), 58-59.

[23] Jack Doyle, *Altered Harvest: Agriculture, Genetics, and the Fate of the World's Food Supply* (New York: Penguin, 1985), cited in Gary L. Comstock, *Vexing Nature?: On the Ethical Case Against Agricultural Biotechnology* (Boston: Kluwer Academic Publishers, 2000), 65.

[24] The CGIAR is a global agricultural research network that was founded in 1971 with membership of governments of developing, transition and industrialized countries, international organizations and charitable foundations. It has for its aim and mission food security and poverty eradication, especially in the Two-Thirds World. See Per Pinstrup-Andersen and Marc J. Cohen, "Biotechnology and the CGIAR," in *Sustainable Agriculture in the New Millennium: The Impact of Biotechnology on Developing Countries*, Conference Proceedings, eds., Kristina Plenderleith and Pieter De Meyer (Brussels: European Union, 2000), 54.

'high tech' in addressing the problem of food security. Even some sectors of the Catholic Church which have been generally more suspicious of science and technology in the area of population control programs have found themselves, wittingly or unwittingly, allies of multinational companies in this venture.[25] Ethical appeal has been made in view of the claim that this gene revolution is the hope that can help solve world hunger and poverty especially in the Two-Thirds World. How realistic is this assumption? How valid is the ethical presupposition? Is 'Gene Revolution' another ugly face, no different from the 'Green Revolution'? Have we not learned from the lessons of Green Revolution?[26]

Food Security – Sovereignty: GMOS in the Context of Political Economy

If green biotechnology is viewed by some as an omnipotent 'benign' science that is able to liberate farmers from the forces of nature, there are others who see it as an "evil instrument in the hands of multinationals to gain greater control over civil society."[27] The latter view is essentially shared by many economists, political critics, activists, scientists, environmentalists and more importantly, by worldwide networks of farmers' organizations who have directly experienced both in the past ('Green Revolution') as well as in the present ('Gene Revolution') the ominous impact of superimposed mechanisms and technologies that are under the control of big agribusiness corporations. The proposition that green biotechnology is the solution to world hunger is dismissed as a mere promotional gimmick of agribusiness firms who are to benefit most from this newly developed technology. The criticism is based on a radically different analysis of the cause of hunger and poverty in the world.

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[25] Italian archbishop Renato Martino of the Pontifical Council for Justice and Peace was reported to be soon publishing a report on the use of biotechnology in agriculture with a favorable verdict. See John Hooper and John Vidal, "Vatican Backing of GM Crops Sparks Church Row," The Guardian-UK, 14 August 2003. hhtp://www.rense.com/general40/gmm.htm (access: 25/08/03).

[26] See Renato C. Salazar, "The Green Revolution and the Lessons to be Learned for the Gene Revolution," and Elenita C. Dano, "Socio-economic Impacts of Agricultural Modernization: Lessons for the Gene Revolution," in *Sustainable Agriculture in the New Millennium: The Impact of Biotechnology on Developing Countries,* 31-32, 36.

[27] George Tzotzos, "Regulation of Biotechnology in LDCs: Implications for Technology Development and Transfer," *AgBioForum 2,* nos. 3 & 4 (1999): 212-214. http://www.agbioforum.org/v2n34/v2n34a10-tzotzos.htm (access: 12/01/04).

The assumption which is based on the Malthusian theory that food production falls short of the needed amount to meet the demands of the ever-increasing population in the world is debunked as a myth.[28] It is argued with convincing evidence that "enough food is available to provide 4.3 pounds for every person everyday: 2.5 pounds of grain, beans and nuts, about a pound of meat, milk and eggs and another of fruits and vegetables."[29] The destruction of farm products due to overproduction in order to protect the prices and market value of such commodities and to ensure high profit, is not an uncommon phenomenon in developed economies. "Malthusian biotechnologists need first to explain why GM crops will feed hungry Indians when 36.6 million excess tons of grain stocks in 'godowns' (silos) of India will not."[30] Argentina, the world's second largest producer of GM crops, underwent a crisis of hunger and malnutrition in 2001, the same year when it "produced wheat enough to feed the people of China and India."[31] The simple proposal to the resolution of the Malthusian equation, 'increase in food production means food security', is not necessarily true. Food, as well as other commodities, is made available only to those who can pay for them with a higher price. Within the new global economic trend of export economy,[32] one understands why food-producing countries of the South have many of their people going hungry. The problem therefore is not production *per se* but distribution. Only a realistic appreciation of the causes of world hunger and poverty can be considered as a valid starting point toward any comprehensive solution to the problem.

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[28] See F. M. Lappé, et al., *World Hunger: Twelve Myths* (New York: Grove Press, 1998).

[29] See F. M. Lappé and B. Bailey, *Against The Grain: Biotechnology And The Corporate Takeover Of Food* (Monroe, Maine: Common Courage Press, 1998).

[30] See Miguel A. Altieri, "The Case Against Agricultural Biotechnology," in *Sustainable Agriculture in the New Millennium,* 16.

[31] See Nicholas Parrott and Terry Marsden, *The Real Green Revolution: Organic and Agroecological Farming in the South,* 4. See detailed study on Argentina by Walter Pengue, "Intensification of Agriculture and Release of Transgenic Crops: Social and Economic Consequences in Third World Countries under the Liberalization and Concentration of the Agribusiness," *Sustainable Agriculture in the Third World*, 71-87.

[32] On the one hand, there are reports saying, "In Mexico over two million corn growers have been displaced by corn dumping by US agribusiness." See A. Mittal, "Politics of Hunger," in *Sustainable Agriculture in the New Millennium*, 7. Yet, on the other hand, "Countries such as Brazil, Paraguay, Thailand, and Indonesia devote thousands of acres of agricultural land to produce soybeans and manioc for export to feed cattle in Europe." See Miguel A. Altieri, "The Case Against Agricultural Biotechnology," in *Sustainable Agriculture in the New Millennium*, 16.

Structural injustice which is maintained by a serious imbalance in the socio-political and economic power resulting in the inequitable access to and distribution of the earth's rich resources is the better explanation to world hunger. Such arrangement typifies the system of liberal capitalist ideology that has succeeded to spread its influence and control worldwide through the aggressive economic processes of globalization.[33] Any serious attempt toward a solution of such a gargantuan problem should be able to give an account of, raise objections against and propose concrete alternatives to, the market and political mechanisms that are responsible for such reality.

The stability of the global system of liberal capitalist ideology is mainly supported by the tripod-pillars of business and finance, pacts and treaties and intelligence agency and the military, with each one having its own specific dynamics.[34] The direct mechanisms of the market include the first two, the areas of consideration for our present investigation. We shall expound how such dynamics operates in the following institutions: (1) monopoly control of the transnational companies (TNCs); (2) international financial institutions like the International Monetary Fund (IMF) and the World Bank (WB); (3) international trade organizations, the most important of which is the World Trade Organization (WTO). Having as a background the long history of exploitation and colonization that resulted in the economic mal-development of the countries in the South,[35] we shall try to

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[33] Ulrich Beck calls this phenomenon "globalism...[which] involves a veritable imperialism of economics, where companies demand the basic conditions under which they can optimize their goals." Ulrich Beck, *What is Globalization?,* trans., Patrick Camiller (Cambridge: Polity Press, 2000), 9.

[34] See Julio Labayen, "A Call to Action Towards an Inclusive Community," Paper presented at the Call To Action National Conference 2000, Milwaukee, WI., USA. http://www.cta-usa.org/conf2000talks.html#labayen (access: 25/9/03).

[35] Thinking along the Dependency Theory developed by fernando Henrique Cardoso and Enzo Falleto, Gustavo Gutierrez says, "It has become ever clearer that underdevelopment is the end result of a process. Therefore it must be studied from a historical perspective, that is, in relationship to the development and expasion of the great capitalist countries. The underdevelopment of the poor countries, as an overall social fact, appears in its true light: as the historical by-product of the development of other countries. The dynamics of the capitalist economy leadd to the establishment of a center and a periphery, simultaneously generating progress and growing wealth for the few, and social imbalances, political tensions, and poverty for the many. See Gustavo Gutierrez, *A Theology of Liberation* (New York: Orbis Books, 1988), 50. See also Fernando Henrique Cardoso and Enzo Fakketo, *Dependency and Development in Latin America,* trans., Marjory Mattingly Urquidi (Berkeley: University of California, 1979).

appreciate how these mechanisms within the so-called system of 'neo-colonialism' operate in the whole business of agricultural biotechnology.

Monopoly Control of Transnational Companies

Transnational companies (TNCs) are considered the world's biggest economic institutions[36] operating in many countries through subsidiaries generally under the management control of the mother company in the country of origin. With historical origins in the early part of the colonization period in the 16th century (British East India Trading Company as one good example), the present mold was identifiable only in the 19th century during the advent of industrial capitalism. Yet it was only in the beginning of the 20th century that TNCs started to steadily gain ground, paving the way for their fuller globalization in the middle of the century while establishing themselves as very powerful institutions in the worldwide economy.[37] The search for resources like minerals, petroleum and foodstuffs and the drive to protect and increase markets were the main motives for the transnational expansion of companies, almost exclusively coming from the United States and from a few Western European nations. Monopolistic concentration and control of the resources and of the market in major sectors like petrochemicals and food were already evident in those years.[38] TNCs' strategies of self-proliferation in profit maximization include the following: exploitation of workers in the South through cheap-labor; labor-contractualization; union-busting; intensive capitalization through the use of automation; monopoly control through merging and corporate acquisition of smaller com-

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[36] It is roughly estimated that "the first 300 largest TNCs own or control at least one-quarter of the entire world's productive assets, worth about US$ 5 trillion." See Jed Greer and Kavaljit Singh, "A Brief History of Transnational Corporations," *Corpwatch 2000*. http://www.globalpolicy.org/socecon/tncs/historytncs.htm (access: 18/8/03).

[37] See the historical account of the growth and power of TNCs in Cleave Ponting, *The Twentieth Century: A World History* (New York: Henry Holt and Company, 1999), 86-106.

[38] As an illustration, US agribusiness giant United Fruit Company controlled 90 percent of US banana imports by 1899; while Royal Dutch/Shell accounted for 20 percent of Russia's total oil production in the beginning of the First World War. See John Dunning, *Multinational Enterprises and the Global Economy* (Massachusetts: Addison-Wesley Publishing Company, 1993), 112 and 114.

panies; tax cuts and avoidance; policy-lobbying in national and international levels to gain favorable laws for better business concessions.

The same goals and mechanisms are evident in the narrative of the agribusiness TNCs. With the rise of green biotechnology, large conglomerate chemical companies have suddenly become interested in absorbing seed research centers.[39] In the effort to monopolize control of the very source of food production, they amass the genetic pool of the South and store them in their gene banks.[40] Genetic plunder does not happen only with plants and animals but extends also to the "human genes and human cell lines from indigenous peoples."[41] Biopiracy very often subtly happens through the instrumentality of bio-prospectors working for biotech firms, pharmaceutical and agribusiness giants that explore and exploit the rich genetic resources of the rainforests of developing countries. It is said that, "[a] staggering 90 per cent of the world's stored germplasm is under the political control of advanced capitalist countries."[42] For commercial purposes, concentration is given to the development of one or a few varieties of crops resulting in monoculture and corollary damage to biodiversity.[43] In fact, the international survey programs in the 1970s and 1980s that called for the establishment of gene banks as public goods was a result of the erosion of centers of origin. But the *in situ* preservation of gene resources is yet to be seen as the introduction of GMOs poses a serious threat to such venture, a point we shall elaborate later, on alternative technology.

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[39] Doyle presents well-documented studies of the corporate take-over of agriculture and food supply. Jack Doyle, *Altered Harvest: Agriculture, Genetics and the Fate of the World's Food Supply* (New York: Penguin, 1985). See also Jack Kloppenburg, *First the Seed: The Political Economy of Plant Biotechnology*: 1492-2000 (Cambridge: Cambridge University Press, 1990).

[40] See Vandana Shiva, *Biopiracy: The Plunder of Nature and Knowledge* (Cambridge: South End Press, 1997).

[41] Mae-Wan Ho, "The Unholy Alliance," in *The Ethics of Food: A Reader for the 21st Century*, ed., Gregory E. Pence (Oxford: Rowman & Littlefield Publishers, Inc., 2002), 81.

[42] See C. P. Geevan, "International Dispute over Political Control of Plant Genetic Resources," *IDOC Internazionale* XVI, 2 (1985): 21.

[43] "Agrochemical companies that provide 100 per cent of commercial transgenic varieties are not considered philanthropic foundations by their shareholders and will not sell on non-solvent markets. Their commercial strategy is to focus on varieties dependent on their chemicals for an ever-increasing range of crops." Robert Ali Brac de la Perriere, "The Diffusion of Transgenic Varieties in Africa: A Technological Transfer Out of Control," in *Sustainable Agriculture in the New Millennium*, 13.

Agribusiness companies ensure returns of profits from their investment on the microbiological researches on the pirated crops and organisms by appealing to the legal mechanism of 'Intellectual Property Rights' (IPRs).[44] This patent mechanism which originally functioned in facilitating the development of one's country,[45] has been transformed in the context of globalization as a tool of big corporations in controlling and preventing free importation and imitation of technological innovations to the so-called 'developing economies'. The development of the South is paid with a heavy price in terms of royalty for the importation of technologies and penalty for non-conformity to patent rules.[46] Such market mechanism has been fully safeguarded by the legally binding agreement on Trade-related Intellectual Property Rights (TRIPS) of the World Trade Organization, a point we shall elaborate later. Notwithstanding the fact that the exploitation of the natural resources of the gene-rich South is left unhampered, the system enables the TNCs to take full control and gain patent rights over life forms and natural processes. The right of local or indigenous farmers over their genetic resources is denied, unfairly depriving them of access to the same resources they have nurtured and conserved over generations. As one dissenting voice asserts, "TRIPS has done little for useful technology transfer, but much in terms of criminalizing people for using their communal knowledge and legalizing corporate theft."[47] Biopiracy through patents is a new form of colonization. If "the old colonization only took over land, the new colonization is taking over life itself."[48]

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[44] See Geertrui Van Overwalle, "The Current IPR Framework for Transgenic Crops and Its Implications for Developing Countries," in *Sustainable Agriculture in the Third Word: Defining A Role for Transgenic Crops and Research*, Proceedings of A Seminar in Brussels, 26-27 March 2001 (Brussels: Koninklijke Academie Voor Overzeese Wetenschappen, 2002), 89-99. The author presents the different legal frameworks of IPR: the international, the European and the United States and their corresponding implications to the Third World. To overcome the disadvantages, he proposes some particular schemes of application of IPR for the developing countries.

[45] See Paul Torremans and Jon Holyoak, *Intellectual Property Law* (London, Edinburgh, Dublin: Butterworths, 1998 [1995]), 6.

[46] Miguel A. Altieri, "The Case against Agricultural Biotechnology," in *Sustainable Agriculture in the New Millennium*, 17.

[47] Dinyar Godrej, "8 Things You Should Know About Patents on Life," *New Internationalist* 349 (September 2002). http://www.newint.org/issue349/keynote.htm (access: 18/9/03).

[48] See "An Interview with Dr. Vandana Shiva," *In Motion Magazine*, 14 August 1998. http://www.inmotionmagazine.com/shiva.html (access: 20/9/03).

The TNCs' ownership of and control over GMOs means dependency of farmers on them for more expensive seeds and other farm supplements or implements. Obviously, the so-called 'Gene Revolution' is but a continuation of the story of the 'Green Revolution', but this time, in a more dangerous phase. This is so because with the science of genetic engineering, plant and seed-breeders could and have already in fact, introduced the terminator technology. This technology, benignly referred to as Technology Protection System (TPS) by more sympathetic camps, ensures that plants cannot live beyond the crop generation, as the seeds born out of them are rendered sterile. There is therefore no way farmers can save seeds for the next season of planting. This explains the general opposition against it in Southern countries. In 1998 farmers protested against Monsanto's use of this technology and prompted the Indian Government to ban it from entering the country. Twenty other African countries declared their opposition to it at a UN Food and Agriculture Organization meeting, prompting Monsanto not to develop it further.[49] In spite of that, the technology has not really been abandoned as new patents on GM sterilization are currently being registered.[50] In fact, it is being argued that the terminator technology is a safety measure against gene flow (an issue we shall later elaborate).[51] The fact that the development of terminator technology was already underway even before the phenomenon of gene flow was first observed negates this weak justification. Monopoly control of food production as the real motive behind this technology seems to us more convincing as it characterizes the overall logic of the TNCs. Maximization of profit is the principal goal. Anything that would achieve it becomes the main consideration. Talks about and gestures of social responsibility and humanitarian concerns like offering solution to world hunger are, at best, advertising strategies or promotional gimmicks. The solution to the problem of poverty and hunger in the Two-Thirds World, as we shall later argue, rests not in those who control and amass wealth and power but on the small farmers themselves who can

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[49] See Ronald Bailey, "Dr. Strangelunch: Why We Should Learn to Love Genetically Modified Food," in *The Ethics of Food*, 112.

[50] "Suicide Seeds on the Fast Track," *Rural Advancement Foundation International (RAFI) Communique,* Issue #64 (February/March 2000). http://www.etcgroup.org/documents/com_suicideseeds.pdf (access:12/01/04)

[51] See Brian Johnson, "The Impact of Modern Biotechnology on Biological Diversity," in *Sustainable Agriculture in the New Millennium*, 44.

get organized as they discover their dignity and innate power to change their social condition. Does this option stand before the big lending institutions that claim to save developing countries from economic crises through financial assistance and loans with imposed development plans?

IMF-WB and the Take-over of National Sovereignty

Conceived in 1945 during the monetary and financial conference in Bretton Woods, New Hampshire, both the International Monetary Fund (IMF) and the World Bank (WB) were created in 1946 to ensure the stability of the globalizing economic system. The IMF was established to promote international monetary cooperation between countries in order to safeguard global financial stability, orderly currency exchange and economic growth;[52] while WB was meant to provide assistance for post-war reconstruction, humanitarian emergencies, post-conflict rehabilitation, poverty alleviation, hunger reduction, as well as other socio-environmental issues.[53] The WB especially helped in the reconstruction of Europe in the aftermath of World War II through the Marshall Plan (named after George C. Marshall). Both institutions have become more and more influential in global policy arena expanding the tentacles of the liberal capitalist ideology around the world. They do so by imposing 'conditionalities' upon developing countries for some loan concessions to allegedly rescue the latter, after having been buried in international debts.[54] Their interventions for the promised 'development' have resulted instead to further impoverishment of the poor.[55] Local governments are forced to take the bitter pill of 'structural adjust-

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[52] See Margaret Garritsen de Vries, "The Bretton Woods Conference and the Birth of the International Monetary Fund," in *The Bretton Woods-GATT System*, ed. Orin Kirshner (New York: M.E. Sharp, 1996), 3-18.

[53] Edward S. Mason and Robert E. Asher, *The World Bank Since Bretton Woods* (Washington, D.C.: The Brookings Institutions, 1973).

[54] "The IMF's economic stabilization package is in theory intended to assist countries in restructuring their economies with a view to generating a surplus on their balance of trade so as to pay back the debt and initiate a process of economic recovery. Exactly the opposite occurs." Michel Chossudovsky, *The Globalization of Poverty: Impacts of IMF and the World Bank Reforms* (Penang, Malaysia: Third World Network, 1997), 68.

[55] Gorringe criticizes the structural adjustment program for its catastrophic effects on the debtor countries. Timothy Gorringe, *Fair Shares*: *Ethics and the Global Economy* (London: Thames and Hudson, 1999), 69.

ment' policies and reforms in order to fit to the global economic scheme of the financial institutions' controlling 'benefactors'.[56] Budget cuts on basic social services and welfare, import-liberalization and removal of restrictions to foreign investors, privatization of state-owned enterprises, deregulation of basic industries, currency devaluation, wage-cuts and weakening of workers' protections are conditions imposed for the main purpose of debt-servicing. It is only when such conditions of the IMF are met that certain development programs are financed by the WB which are often tied down with the interest of TNCs. Within the specific area of our investigation, it can be safely asserted that the WB has been in close collaboration with big agribusiness in promoting the commercialization of the GM crops. It is true that the WB has shown interest in coming up with risk assessment of GM crops as indicated by its expressed commitment in the 2001 World Summit for Sustainable Development in Johannesburg. But such a plan has already been preceded by its development programs that include introduction of GM crops to agriculture.[57]

The above mechanisms of the global financial institutions fit well with the interest of those benefited by the system. In the process, national sovereignty becomes the number one fatality and some governments are just happy to attend its funeral as that would enable them to plunder its wealth. This obviously means tragedy and devastation for the majority of the population, pushing the poor toward greater misery.[58] Even as we concede that

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[56] It is interesting to note that Robert McNamara served as president of the WB (1968-1981) after his troubled stint at the US Defense Department. It was during the last years of his office when the 'Structural Adjustment' was imposed by the IMF-WB. See Walden Bello, *Deglobalization* (Bangladesh: The University Press Ltd., 2002), 38-39. See also in the same work how the United States, safeguarding its pre-eminent shareholder role, dominates and controls the WB and IMF with 4 others of the world's largest economies, 59-63.

[57] Ethiopia, Brazil, Indonesia and Peru have been cited as countries enjoying financing from WB for biotechnology research and applications. In Kenya, a certain Dr. Florence Wambugu, whose professional education and training was sponsored by Monsanto, has been identified as a spokesperson for Africa's need for GMOs. See Pesticide Action Network Updates (PANUPS), "World Bank Forges Ahead with Transgenic Crops," in *Organic Consumers' Association,* 27 September 2002. http://www.organicconsumers.org/corp/worldbankge.cfm (access: 17/10/03).

[58] Based on the study by the Center for Economic and Policy Research, Bello claims that 77 per cent of countries saw their per capita rate of growth fall significantly from 1960-80 to 1980-2000, the period of structural adjustment. The number of people living in poverty and surviving with less than a dollar a day increased from 1.1 billion in 1985 to 1.2 billion in 1998 and was expected to reach 1.3 billion by 2000. See Walden Bello, *Deglobalization*, 68-69.

corruption in local governments accounts for hunger and poverty in the Two-Thirds World, the mechanisms of the IMF-WB, in partnership with the TNCs, are surely responsible for many of the financial and economic mess in those countries.[59] What about the third and relatively more recent mechanism of the system, the WTO?

Legal/Structural Support to the Global System: World Trade Organization (WTO)

The World Trade Organization (WTO) was founded in 1995 following the signing of the Marrakesh Accord in 1994 which provided an international legal structure and real coercive teeth for the implementation of the eight-year Uruguay Round of the General Agreement on Tariffs and Trade (GATT, 1986-1994). In a multilateral way, it aims to remove protectionist controls in national markets in order to fully open them up to the global system of free enterprise that erases all economic borders. Many local *economies* (how nation-states are now called) have been finally seduced to jump metaphorically into the center stage of promised development disregarding the danger of finding themselves like lightweight amateurs against heavyweight champions in the boxing ring of unfair competition. How can the small farmers of the South compete with the big farmers or agribusiness firms of the North who receive big subsidies from their governments? When the local markets in the South become dumping grounds of cheap goods overproduced in the North, the result is tragedy for the local and small farmers. The new global arrangement safeguards the capital investments of big economic players with laws that make local governments "increasingly less answerable to the needs and desires of their citizenry."[60] The implication of the global mechanism to local economies is well articulated by Su-

[59] See Walden Bello's essay, "Meltzer Report on Bretton Woods Twin Builds Case for Abolition," first published in *Focus on Trade*, April 2000, republished in Walden Bello, *The Future in the Balance: Essays on Globalization and Resistance* (Quezon City: University of the Philippines Press, 2001), 59-63. The report of the International Financial Institution Advisory Commission (known as Meltzer report) is significant as it comes from an insider of the system, Alan Meltzer, who rearticulates essentially the corpus of literature coming from the more progressive critics such as Cheryl Payer's *The Debt Trap*, Bruce Rich's *Mortgaging the Future*, etc.

[60] Helen Norberg-Hodge, Peter Goering, and John Page, "From Global to Local: Sowing the Seeds of Community," in *The Ethics of Food,* 191-214, esp. 201.

san George who claims that "the WTO has created an international court of justice that is making law and establishing case law in which existing national laws are all 'barriers' to trade and is sweeping aside all environmental, social or public health considerations."[61] Developing economies may lobby and demand for their interests and the protection of their constituencies (more for the big landowners than small landless farmers) but there are surely more powerful voices in the negotiating table. This was very clearly demonstrated in the most recent meeting, the fifth ministerial conference in Cancún, Mexico (10-14 September 2003). The opposition of the developing countries (G-21) against the protectionist scheme in terms of heavy subsidy to farmers in the developed economies was non-negotiable. This dead-end in the negotiation left the conference to a total failure in reaching any substantial agreements. The paternalism that goes with the rhetoric of some representatives of powerful economies in putting forward their own agenda illustrates that WTO is their game. Becoming a member of WTO should therefore mean willingness to play that game according to their pre-established rules.

This makes us see why Walden Bello speaks about the creation of WTO as a victory of the big Western liberal economies, particularly of the US, in overcoming the threats that result from the economic exchange and network building among economies in the South. The WTO has rendered the United Nations Conference on Trade and Development (UNCTAD) impotent and its vision for a New International Economic Order (NIEO) dimmer. Since its foundation in 1964, UNCTAD has become the principal vehicle for the Two-Thirds World countries to restructure the world economy, obstructing the economic aggression and hegemonic control of the economic superpowers while strengthening themselves through network building and organizations.[62] If the UNCTAD became the institution where developing countries gravitated in order to pursue the process of economic

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[61] Susan George, "Trade Before Freedom," *Le Monde Diplomatique*, November 1999. http://www.mondediplo.com/1999/11/02george?var_recherche=susan+george,html (access: 25/8/03).

[62] With the establishment of UNCTAD also came other new economic power blocks and trade-networks such as the Organization of Petroleum Exporting Countries (OPEC), Non-Aligned Movement, Group of 77 and the New International Economic Order (NIEO). See Walden Bello, *Deglobalization: Ideas for a New World Economy*, 34-5.

decolonization, the leading governments relied on the International Monetary Fund (IMF) and World Bank (WB) to push for their agenda. These twin institutions of the Bretton Woods System have only found their third pillar in the long overdue creation of the WTO which was meant to do for trade what the IMF did for finance and the WB for economic reconstruction. In fact, it is the WTO that liaised as the key institution for the rich countries' multilateral control over and governance of the global economy. The rich countries, we refer to, are the leading industrial economies, who, since 1975 in Rambouillet, France, have formed themselves into an exclusive Group of Seven (G-7), now the G-8 (with the post-Soviet Russia admitted during its summit in Denver), coordinating and controlling the macroeconomic policies. Through a peculiar way of consensus-building in the WTO where big trading countries impose their consensus on the smaller ones, the economic interests of the G-7 and a few others are guaranteed, jeopardizing fairness and justice to the 147-member global economic body. One specific way we see how the WTO protects such interest is in the field of food and agri-biotechnology.

Providing legal structure to all other market mechanisms in agriculture, the WTO enters the picture of biotech business through the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) which came into force in 1995. Being a member of the WTO implies adherence to the TRIPS which defines the rules on trademarks, copyrights and patents. The patent right gives monopoly control over products or goods to their inventors for a designated number of years. What has become a contentious issue is the question on patent rights especially over 'life forms'. TRIPS' provision on Section 5, Article 27, paragraph 3 b, states:

> Members may also exclude from patentability, (b) Plants and animals other than microorganisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological process. However, members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof. The provisions of this sub-paragraph shall be reviewed four years after the date of entry into the WTO Agreement.

The above stipulation which apparently prohibits patent rights over plants and animals, actually authorizes patent on life-forms and microbiological

processes. This merely articulates in a more subtle way what appears in the text of number 35 of the United States Code 161 on patents for plants which reads as follows:

> Whoever invents or discovers and asexually reproduces any distinct and new variety of plant, including cultivated sports, mutants, hybrids, and newly found seedlings, other than a tuber propagated plant or a plant found in an uncultivated state, may obtain a patent thereof, subject to the conditions and requirements of this title. The provisions of this title relating to patents for inventions shall apply to patents for plants except as otherwise provided. (Amended September 3, 1954, 68 Stat. 1190)

The TRIPS' stipulation qualifies the US patent code by excluding plants and animals and essential biological processes, yet still speaks indirectly of the patentability of microorganisms and microbiological processes. Some scientists have raised questions whether microbiological processes can be considered technical and not even essentially biological. Moreover, the assumption that such microbiological interventions are inventions and not just discovery is still debatable.[63] What we have here is nothing but a clear attempt to protect the TNCs' control of agro-biotechnological processes and GM crops and organisms without due consideration of the right of those agricultural communities who have developed and preserved those seeds for centuries. Moreover, one wonders what could be more essential to a biological process than the 'blueprint' of life, i.e., the gene. Whoever controls the seeds (because of some legally claimed microorganic processes like genetic engineering), controls the food chain and therefore life itself. To legally give to profit-oriented agro-firms the 'grants'[64] of monopoly control over the very source of life would definitely mean devastation for those who could not pay access to them for survival. The legal mechanism of the World Trade Organization's agreement on TRIPS is not at all an incentive to inventive endeavors for the common good but an outright and

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[63] This question extends to genetic mapping and sequencing which John Sulston, the 2002 Nobel Prize winner in physiology or medicine, considers as public good. John Sulston, "The Heritage of Humanity," *Le Monde Diplomatique*, December 2002. http://mondediplo.com/2002/12/15genome (access: 21/10/03).

[64] See Number 35, United States Code 163 Grant for patent rights (Amended 27 Oct. 1998, Public Law 105-289, section 3, 112 Stat. 2781).

shameless legitimization of biopiracy and theft by agribusiness corporations of the lifeline resources that should be made available to all.

To conclude this section, we can assert that the introduction of the GMOs within the social-economic context of globalization disproves the claim that it is the solution to world hunger and a way of alleviating poverty in the Two-Thirds World. Agricultural biotechnology is not a tool that would empower the poor to compete with the developed economies but a death-trap that would make them depend more completely on the TNCs for their survival. It is only with the empowerment of the small farmers,[65] who are able to have sovereignty over food production and distribution, can food security for all be better addressed and safeguarded. Any system or technology which pushes them further to marginalization and disempowerment is doomed to fail in their efforts to solve the global problem of hunger.

The next immediate question one may ask is: once the socio-economic context changes, will it be good to venture into agricultural biotechnology? Sharing our general distrust on GM commercialization with all the complications that go with it, a plant biologist, Anthony Trewavas, claims that "[w]e can't eliminate knowledge simply because someone makes a profit out of it."[66] This leads us to another level of investigation. It is equally important to ask whether the biotech food that is promised to find its way to the dining table of the poor is safe in satisfying the present hunger and sustainability for the environment they live in.

Food-Safety and Gene-Integrity: GMOs vis-a-vis Health and Environment

The debate in the North about the introduction of GMOs has been more focused on the question of health and its overall impact on the environment. In highly safety-conscious societies, consumers want healthy food

[65] Naomi speaks about the campaigns against globalization as a fight "for the rights of local communities to have a say in how their resources are used, to make use that the people who live on the land benefit directly from its development." Naomi Klein, "Reclaiming the Commons," *New Left Review* 9 (May-June, 2001): 88.

[66] Anthony J. Trewavas, "GM Food Is the Best Option We Have," in *The Ethics of Food*, 149.

on their dining table and producers want safe seeds in their farms. Compared to the US, GMOs are received with greater suspicion in the European markets and farmlands.[67] More conscious of the risks that have resulted from the scientific innovations that modernity's obsession for steady progress has brought about in society,[68] the European public is more careful this time to be open to the promises of new and untested technologies. The temporary moratorium on the commercialization of new GM crops in 1998 and which was later substituted by the labeling requirements for the importation of GMOs to Europe formed part of such precautionary posture. At the forefront of the struggle for a healthy ecology against 'corporate greenwash' are scientists, environmentalists and big farmers' organizations. We shall investigate in this section what they say about the possible effects of GMOs to human health and its impact to the environment. We shall likewise investigate processes and mechanisms that ensure protection and safety vis-à-vis the proposed introduction of biotechnology especially in Europe.

Agribusiness GM seed producers claim that human health and environmental safety are of outmost importance to them. They argue that GMOs are safe and healthy on the following grounds: (1) There has been no evidence to the contrary; (2) There are sufficient regulations and checks by Government Food and Drug Administration (FDA) to guarantee it; (3) Genetic engineering is a sure way to make farm products address health concerns and needs. It is a better alternative to old approaches to agriculture, like organic farming, which are hazardous to health; and lastly, (4) Genetic modification is just the latest in the 'seamless' continuum of biotechnology practiced by humans since the dawn of civilization. These are the reasons commonly given to seduce unsuspecting farmers and to counter allegations of dissident and questioning non-believers. We shall elaborate these points and see how they stand before the more compelling arguments and evidences presented by the scientists of the opposite camp.

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[67] Lambrecht documents the political storm surrounding GMOs. See Bill Lambrecht, *Dinner at the New Gene Café: How Genetic Engineering is Changing What We Eat, How We Live, and the Global Politics of Food* (New York: St. Martin's Press, 2001).

[68] See Ulrich Beck, *Risk Society: Toward a New Modernity*, trans., Mark Ritter (London: Sage Publication Ltd., 1998 [1992]). He speaks of the negative effects of technical interventions in nature which generate risks and cause damages to human life and whose long-term and uncertain consequences cannot be assessed.

Dangerous Consequences to Human Health and the Environment

It has been persistently argued that there are no proven negative effects of the GMOs both to health and environment. There has been no report about any GMO-related diseases among tens of millions of American consumers who since 1995 have been eating biotech crops. With an estimated 60 percent of foodstuff on US grocery shelves produced using ingredients from transgenic crops, the dangers would have manifested by now. In a report that was published in the US under the auspices of seven scientific academies of various countries, there is a claim that "[t]o date, over 30 million hectares of transgenic crops have been grown and no human health problems associated specifically with the ingestion of transgenic crops or their products have been identified."[69] This generalization not backed up by controlled field studies (no citation of any short-term and long-term research) of the real effects of GMOs to human health is, at best, propaganda in the battlefield of green biotechnology. What we have instead is the evidence that is furnished in the most recent report on the result of the GM crops field trials in the UK, the largest scientific experiment of its type on GM crops undertaken anywhere in the world. The report concludes that "two of the three GM crops grown experimentally in Britain, oil seed rape and sugar beet, appear more harmful to the environment than conventional crops."[70] The third crop, GM maize, has not shown risk, at least in the period of the experiment. Furthermore, what has been generally observed according to the 1996 World Health Organization Report is that over the past 20 years at least 30 new diseases including AIDS, Ebola and Hepatitis C have begun infecting some populations; while old diseases like tuberculosis, cholera, malaria and diphtheria have made a comeback worldwide. "Geneticists have now linked the emergence of pathogenic bacteria and of antibiotic resistance to horizontal gene transfer – the transfer of genes to unrelated species, by infection through viruses, through pieces of genetic material, DNA, taken up into cells from the environment, or by unusual

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[69] Report prepared under the auspices of Royal Society of London, et al., *Transgenic Plants and World Agriculture* (Washington DC: National Academy Press, 2002), 15. http://www.nap.edu/html/transgenic/index.html (access: 25/9/03).

[70] Paul Brown, "GM Crops Fail Key Trials Amid Environmental Fear," *The Guardian*, 2 October 2003. http://www.guardian.co.uk/gmdebate/Story/0,2763,1053917,00.html (access: 2/10/03).

mating taking place between unrelated species."[71] What seems to provide evidence, contrary to the assumption of safety, was the controversial experiment conducted by Dr. Arpad Pusztai and Stanley Ewen on rats fed with GM potato which had ill effects to the rats' gastrointestinal tract.[72] What we have here is a case of horizontal gene transfer, a phenomenon that is verified in the studies conducted by Dr. Vitaly Citovsky from the State University of New York and his colleagues who "found that the plant bacterium was able to attach to human cells and insert its DNA into human cells just as it does with plant cells."[73] The above accounts of the dangers of GMOs resonate well with the assessment of genetic engineering by the 1995 Nobel Prize winner British physicist, Joseph Rotblat who says, "My worry is that other advances in science may result in other means of mass destruction, maybe more readily available even than nuclear weapons. Genetic engineering is quite a possible area, because of these dreadful developments that are taking place there."[74]

That brings us to another important consideration of the danger of GMOs, i.e., their ill effects on the environment. Environmentalists speak of direct and indirect harm that GMOs can inflict on the environment. Toxicity and gene-flow have been identified as serious environmental concerns among the direct effects.[75] As far as toxicity is concerned, we can refer to the laboratory experiments conducted by some scientists who have found pollens from Bt corn to be toxic to monarch butterflies when they land on milkweed of the plant on which they feed.[76] With regard the phenomenon

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[71] See Mae-Wan Ho, "The Unholy Alliance," in *The Ethics of Food*, 90.

[72] See Stanley Ewen and Arpad Pusztai, "Effects of diets containing genetically modified potatoes: expressing Galanthus Nivalis lectin on rat small intestine," *The Lancet* 354, no. 9187, 16 October 1999. http://www.biotech-info.net/galanthus.html (access: 20/10/03).

[73] Emma Patten Reuters, "Tumor-Causing Plant Bacteria May Infect Human Cells," *Reuters Health News* 31 January 2001. http://www.biotech-info.net/tumor_causing.html (access: 20/10/03).

[74] Joseph Roblat, "The Specter of a human clone," *The Independent* (26 February 1997), 1.

[75] Brian Johnson, "The Impact of Modern Biotechnology on Biological Diversity," 43- 46, cited in Anthony Barnett, "GM Genes 'jump species barrier," *The Observer,* 28 May 2000. http://www.observer.guardian.co.uk/uknews/story/0,6903,319418,00.html (access: 30/8/03).

[76] See Laura C. Hansen, Jesse and John J. Obrycki, "Field Deposition of BT Transgenic Corn Pollen: Lethal Effects on the Monarch Butterfly," *Oecologia*, 19 August 2000. Pro-GMOs argue that it is the case only in laboratory-based experimentations that do not represent actual field conditions as more recent studies conclude. See Val Giddings, "BIO Statement Regarding Purported New Findings on Bt Corn and Monarch," Press Release, 21 August 2000. http://www.checkbiotech.org/root/index.cfm?fuseaction=briefings&keyword_id=76 (access: 20/10/03).

of gene-flow, it has been observed that variety crops that have been modified with an alien gene from different organisms affect other plants through the natural process of cross-pollination.[77] Just as gene-flow has been proven to take place naturally with sexually compatible wild relatives,[78] there are also indications that it occurs between non-related species, i.e., cross-species gene transfer.[79] Thus, the danger of the development of 'superweeds' as well as the evolution of other agricultural pests cannot be ignored. Gene-pollution can happen when the herbicide resistant gene finds its way to the weeds making it resistant even to very strong chemical herbicides. When a particular virus infects a plant that is genetically modified with a viral gene, the invading virus can add that viral gene to itself through the process of recombination, a phenomenon widely accepted by molecular virologists. Pro-GMOs argue that the Technology Protection System (TPS), or the so-called 'terminator gene', could address the problem of gene-pollution. Yet, knowing the real motive of 'invention' of such technology makes us reject such proposed solution. Besides, there are other indirect negative effects to the environment that are equally serious. Altieri succinctly describes them together with the other dangers we have elaborated above:

> Transgenic crops pose a range of potential environmental risks that threaten the sustainability of small farming systems. The ecological effects of engineered crops are not limited to pest resistance and creation of new weeds and pollution of landraces. Transgenic crops can produce environmental toxins that move through the food chains, and also may end up in the soil and water affecting invertebrates, and probably ecological processes such as nutrient cycling. Moreover, large-scale landscape homogenization with

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[77] CECCAM, CENAMI, CASIFOP, UNOSJO, AJAGI, "9 Mexican States Found to be GM Contaminated," *Gene Flow,* Press Release*,* 09 October 2003. http://www.biotech-info.net/mexican_contamination.html (access: 20/10/03).

[78] The US Commission of Life Science points out that "the incidence of hybridization between genetically modified crops and wild relatives can be expected to be lower here (in the US) than in Asia Minor, South East Asia, the Indian subcontinent, and South America and greater care may be needed in those regions." See Report, *Field Testing Genetically Modified Organisms: Framework for Decisions* (Washington DC: National Academy of Sciences, 2002), 47.

[79] See Michael Syvanen, "Horizontal Gene Transfer: Evidence and Consequences*," Annual Review of Genetics* 28 (December 1994): 237-261. http://www.dcn.davis.ca.us/vme/hgt/AnnuRevGenVol28pp237-261yr1994.PDF (access: 18/10/03).

> transgenic crops will exacerbate the ecological vulnerability already associated with monoculture agriculture.[80]

The fact that the evidence of risk and harm that GMOs can cause both to human health and the environment is undeniable, the more reasonable posture should be that of rejection of the said technology. It may be true that there are GM applications that have not been proven to be damaging; but considering that there is a high level of uncertainty involved where no risk assessment can be reliable in knowing the long-term effects of green biotechnology, Hans Jonas' methodological approach of a 'heuristic of fear' should be allowed to guide our moral choices as well as public policies and actions.[81] Governments should adopt the precautionary principle articulated in the 1998 Wingspread Convention. "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."[82] How this principle enters into the specific regulations on green biotechnology is the next focus of our investigation.

The Politics of Regulation on Human Safety and Biological Diversity

Pro-GMOs argue that even if it could be assumed that there are risks involved in the introduction of genetic biotechnology, as there cannot be any ideal situation where we can have 100 percent freedom from risks, there are enough safeguards in terms of regulations and institutions[83] that

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[80] Miguel A. Altieri, "The Case Against Agricultural Biotechnology: Why are Transgenic Crops Incompatible with Sustainable Agriculture in the Third World?" in *Sustainable Agriculture in the New Millennium*, 15. See also his other article, "The Ecological Impacts of Transgenic Crops on Agroecosystem Health," *Ecosystem Health* 6 (2000): 13-23.

[81] Hans Jonas, *The Imperative of Responsibility: In Search of An Ethics for the Technological Age* (Chicago: University of Chicago Press, 1985).

[82] See "Wingspread Statement on the Precautionary Principle," in *The Networker* 3, 1 (March 1998) of the Science and Environmental Health Network. http://www.sehn.org (access: 15/1/04). See also Joel Tickner and Carolyn Raffensperger, eds., *Protecting Public Health and the Environment: Implementing the Precautionary Principle* (Washington D.C.: Island Press, 1999).

[83] Principal U.S. federal regulatory organizations for consumer protection include: the Department of Health and Human Services (DHHS), Food and Drug Administration (FDA), the U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS) and Animal and Plant Health Inspection Service (APHIS) and the Environmental Protection Agency (EPA).

can ensure the safety of public health and the environment. Some U.S. government agencies claim that concerns over the impact of the transgenic crops and food to both the environment and human health "ha[ve] led world governments to reassess the standards by which they determine just what constitutes a significant negative effect of agriculture to the environment."[84] The U.S. Food and Drug Administration text claims that "U.S. food safety statutes, regulations, and policies are risk-based and have precautionary approaches embedded in them."[85] A critical remark to introduce the said text notes that the document is silent on how closely the various agencies are connected to huge agribusinesses with links to key politicians.[86] Such comment makes a lot of sense when one understands the connivance that happens between government agencies and big corporations falsifying the claim of transparency in public policy-making. "Regulations are, in fact, highly mutable, subject as any other laws to changes in the political climate. Enforcement is often selective and… officials can easily bend the rules on behalf of powerful economic interests."[87] If governments in supposedly highly developed economies like the US betray their own people, one wonders how safe the public would be in the South where many of the governments are subservient to the economic superpowers and are beholden to the TNCs. Besides, even among those who want to safeguard public health may not necessarily have the national structures for biosafety that might be realistically implemented .[88]

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[84] See Report of Board of Agriculture and Natural Resources et al, *Environmental Effects of Transgenic Crops: The Scope and Adequacy of Regulation* (Washington DC: National Academy Press, 2002).

[85] The system of risk analysis includes risk assessment, risk management, risk communication. U.S. Food and Drug Administration, "The United States Food Safety System," in *The Ethics of Food*, 268.

[86] Miller speaks of strong regulation based on scientific principles. But he criticizes the FDA's recent creation of the Codex task force which he vehemently opposes for its risk-based approach. See Henry I. Miller, "The FDA's Volte-Face on Food Biotech," in *The Ethics of Food*, 97-99.

[87] Brian Tokar, *Earth For Sale: Reclaiming Ecology in the Age of Corporate Greenwash* (Boston: South End Press, 1997), 57. See also Vandana Shiva, "Violating People's Rights, Protecting Corporate Profits – The US Interpretation of the Biodiversity Convention," *Third World Resurgence* 34 (June 1993): 2-3.

[88] See Robert Ali Brac de la Perriere, "The Diffusion of Transgenic Varieties in Africa: a Technological Transfer Out of Control," in *Sustainable Agriculture in the New Millennium*, 13.

The safety and protection of the public and the environment seem to depend more on civil society. Historically, it has been through the advocacy of movements in civil society that persuaded some governments to enact the institutionalization of the value for environmental protection and safety measures that eventually found their way in international conventions and agreements. The Convention for Biological Diversity (CBD), whose creation was agreed upon in the 1992 Earth Summit in Rio de Janeiro in order to pursue a comprehensive strategy for 'sustainable development', may be considered as one of the monumental victories of such movements. Since its first ordinary meeting in 1994 in Nasau, Bahamas,[89] the CBD has made many decisions to protect biological diversity as well as the interests and rights of developing countries, among which is the recognition of national sovereignty over all genetic resources. Furthermore, it was through the extraordinary meeting of the CBD that the so-called Cartagena Protocol on Biosafety (CPB)[90] was called to existence. The Protocol is another landmark in the struggle for a safe and sustainable world. It makes reference to a precautionary approach and reaffirms the precaution language in Principle 15 of the Rio Declaration on Environment and Development. CPB also establishes a Biosafety Clearing-House to facilitate the exchange of information on living modified organisms and to assist countries in the implementation of its rules. In particular, CPB demands, among other things, that all shipments of biotech crops should be labeled with "may contain 'living modified organisms'."[91] The protocol also gives right to governments to refuse the importation of GM crops on the basis of the precautionary principle.

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[89] The subsequent ordinary meetings were held in the following countries, Jakarta, Indonesia in 1995; Buenos Aires, Argentina in 1996; Bratislava, Slovak Republic in 1998; Nairobi, Kenya in 2000; The Hague, The Netherlands in 2002; and the next meeting will be in Kuala Lumpur, Malaysia in 2004.

[90] Named after a city in Colombia, Cartagena is the historic site where the protocol was presented to the first extraordinary conference of the parties in 1999. It was later presented to intergovernmental meetings for discussion and for final approval. See brief historical background of the Cartagena Protocol on Biosafety from http://www.biodiv.org/biosafety/background.asp#.

[91] See Cartagena Protocol on Biosafety, Article 18.2(b) "Living modified organisms that are destined for contained use clearly identifies them as living modified organisms; and specifies any requirements for the safe handling, storage, transport and use, the contact point for further information, including the name and address of the individual and institution to whom the living modified organisms are consigned." Shiva criticizes the text for its use of the phrase, 'living modified organism' instead of 'genetically modified organism', a compromise acceptable to the U.S. representatives.

Agribusiness firms lobby for the dropping of the provision that requires the labeling of GM products. They argue that it is giving undue prejudice to the production of particular goods especially after scare tactics drive consumers away from GM foods given ominous name such as *frankenfoods*.[92] Yet, one can argue that consumers have the right to know or be informed of the quality and source of what they wish to procure.

The Better Alternative Technology toward a More Sustainable Life

The agribusiness firms' commitment to health, it has been argued, is certified by their investments in ventures that help improve the capacity of crops to provide for the health needs of the population. 'Golden rice'[93] has been cited as an example of how genetic engineering can solve the problem of vitamin A deficiency. When there are 180 million children suffering from malnutrition and deficiency disorders, with 2 million dying every year, or iron deficiency that affects 2 billion and causes anemia in half the number, Parsley asks why should a newly found solution, i.e., agricultural biotechnology, be stopped.[94] Should we not then concede to Trewavas, a molecular biologist who claims that, "GM food is the best option we have."[95] Doubts are raised regarding organic farming, an alternative technology that anti-GMOs would like to offer. Besides not having better nutritive value, pro-GMOs assert, organically produced crops are even hazardous to health. Falsifying the myth of the safety of organic food, Gregory Pence cites cases of food-borne illnesses caused by *E. coli* bacteria that are contained in ma-

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[92] See Ronald Bailey, "Dr. Strangelunch: Why We Should Learn to Love Genetically Modified Food," in *The Ethics of Food*, 106.

[93] The so-called 'Golden Rice' 'invented' by Professor Potrykus and Dr. Peter Beyer contains pro-vitamin A which results from the combination of three genes: two from a daffodil flower and one from a bacterium via a metabolic pathway in rice endosperm. Adrian C. Dubock, "Sustainable Biotechnology: Golden Rice and Co-operation between the Public and Private Sector," *Sustainable Agriculture in the New Millennium*, 9.

[94] See J. G. Parsley, "Agricultural Biotechnology and the Poor: Promethean Science," in *Agricultural Biotechnology and the Poor*, 10.

[95] He argues that we need not eliminate knowledge that offers solution to some fundamental problems on the basis that we distrust the commercialization that goes with it. Anthony J. Trewavas, "GM Food Is the Best Option We Have," in *The Ethics of Food*, 148-155.

nure used for organic farming.[96] He even goes on to say that organic farming is a back-breaking job and washing manure away from organically produced crops, boring. Dismissing as myth the plea for organic farming as environmentally friendly, Pence says, "At least we know that organic food is better for the world's environment, right? Not so. Indeed, just the opposite. Chemical fertilizers that utilize nitrogen in the atmosphere cannot be used in organic farming, which instead must use animal manure for crops that don't fix their own nitrogen."[97] Considering that 80 million tons of nitrogen nutrients are used each year, according to Norman Borlaug, then that "would require an additional 5 or 6 billion heads of cattle to supply the manure."[98] On the weight of this argument, the major supplier of organic food to England and Europe, Icelandic Incorporated, has been accused of destroying forests and grasslands in Ecuador. GM crops are more environment-friendly because they require no or minimal use of herbicides and even external farm supplements.

A closer examination of the reality casts doubts about the veracity of the above assumptions. As to the claim that GMOs are environmentally friendly, it is not (completely) true that using GM crops has minimized the use of herbicides. In many cases, the use of herbicides has increased both in quantity and quality especially with herbicide-resistant transgenic crops. Such are Monsanto's Roundup Ready soybeans eliminating indiscriminately all other living organisms in the farm and consequently destroying the healthy interrelationship within the cosmic order of the environment. In regard to the promise of healthier food such as the Golden Rice, Altieri's apologia is an appeal to common sense and wisdom: "A magic-bullet solution, which places beta-carotene into rice while leaving poverty, poor diets, and exten-

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[96] Pence mentions the case of a particular type strain (0157:H7) of *E. coli* bacteria which sickened over 73,480 Americans in 1999 according to the Center for Disease Control. There was also, according to him, a case in 1993 of seven hundred people infected with the same *E. coli* after eating undercooked hamburgers served by a particular fast-food chain. See Gregory E. Pence, "Organically or Genetically Modified Food: Which is Better?" in *The Ethics of Food*, 117.

[97] Gregory Pence, "Organically or Genetically Modified Food: Which is Better?," *The Ethics of Food*, 120.

[98] Norman Borlaug, "Taking the GM Food Debate to Africa: Have We Gone Mad?" open letter to the editor, *Independent Newspaper*, London, 10 April 2000, cited in Gregory E. Pence, "Organically or Genetically Modified Food: Which is Better?" in *The Ethics of Food*, 120.

sive monoculture intact, is unlikely to make any durable contribution to well-being."[99] Allowing more variety of green leafy vegetables to grow around or interspersed with the main crop is still better than their substitutes in GM rice in solving nutritional deficiency and malnutrition. The real problem of malnutrition and dietary illnesses is not the lack of vitamin in rice but primarily the people's lack of access to a more varied diet because of poverty. Aware of the real causes of poverty, we see that the appropriate response is not genetic engineering but a good social engineering. Organic farming technology can gradually and ultimately help achieve such goals.

The criticism laid down against organic agriculture betrays the critics' ignorance of that technology. Parrott and Marsden give us a comprehensive study of the very promising performance of what they refer to as the 'real Green Revolution', i.e., the organic and agro-ecological farming in the South.[100] Becoming increasingly more popular among farmers' communities and organizations[101] as well as consumers and patrons, the so-called agro-ecological farming technology is a very feasible alternative in achieving food security and sovereignty as well as environmental sustainability. Parrott and Marsden's study bears out very encouraging data and statistics that serve as incentives in promoting this alternative technology. We summarize them as follows: (1) increasing farmers' income; (2) increasing yields

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[99] Miguel A. Altieri, "The Case Against Agricultural Biotechnology: Why Are Transgenic Crops Incompatible With Sustainable Agriculture In the Third World?" in *Sustainable Agriculture in the New Millennium*, 17.

[100] See Nicholas Parrott and Terry Marsden, *The Real Green Revolution: Organic and Agroecological Farming in the South* (London: Greenpeace Environmental Trust, 2002). See also David Tilman, "The Greening of the Green Revolution," *Nature* 19 (November 1998): 211-212.

[101] Organic growers belong to the big network of International Federation of Organic Agricultural Movements (IFOAM), two-thirds of new members of which come from the South. There has been an approximately 15.8 to 30 million hectares (3% of the total agricultural land in the South) used for organic farming. 65% of rice and 50% of fresh vegetables are organically produced in Cuba. In the Philippines, organic farming, identified as MASIPAG technology, is still practiced in very limited capacity (9 farms with the mean size of 10.6 hectares, according to 1999 survey). See Nicholas Parrott and Terry Marsden, *The Real Green Revolution: Organic and Agroecological Farming in the South*, 4. For more data on the Philippines, see Samson, R. et al, "The Flora Community: A Developing Agroecological Village in the Philippines that is Green House Gas Friendly," in *The World Grows Organic: Proceedings of the 13th International IFOAM Conference*, eds., Alfoldi et al (Basel, Switzerland: IFOAM, 2000); see also GAIN Report, *Philippines: Organic Market Brief 2000* (RP0015, USDA).

and productivity; (3) improving soil fertility and long term sustainability of farming systems; (4) reducing farmers' dependency on artificial inputs and the exposure of rural populations and environments to their side effects; (5) assisting with the restoration of degraded or abandoned land; (6) maintaining and improving biodiversity; and (7) promoting and valorizing local knowledge and building self-confidence in small farmers. Along a more 'deglobalized' approach to agriculture, organic farming brings back to the small farmers and their communities the capacity for crop production and food distribution. Within this manageable and localized scheme that respects cosmic balance, Borlaug's concern about the need for an enormous amount of manure and its ecological consequences simply loses sense.

We would have conceded to Trewavas that GMOs would be the best option, if there were no other feasible alternative. But the above study shows that organic farming is even better as it promises a better future for the poor and small farmers of the Two-Thirds World, both in terms of their empowered productive capacity, evident in their agricultural yields and real income, but more so, in terms of their self-confidence in directing and managing their life and productive activities according to their homegrown wisdom and knowledge. It may not be very easy as it may continue to be back-breaking in some instances and may have to require a careful management of its produce for safe public consumption. But it is a steady and a sure path that can genuinely bring about a sustainable life for the majority of the poor and their environment at the present and in the future.

The More Appropriate Scientific Model in Understanding Life

Pro-GMOs claim that genetic biotechnology is just the latest and most advanced methodology and technique employed to improve the natural resources in order to better serve human needs. As a highly developed and exact way of handling organisms, biotechnology is even a lot safer than the traditional and conventional approaches to farming. It involves the introduction of one or, at most, a few well-defined genes rather than the introduction of whole genomes or parts of chromosomes done in traditional plant breeding. That does not make the whole process significantly different but it makes the selection of desired qualities more beneficial to the

crops. Moreover, GMO apologists argue that science and technology have to progress, overcoming the limitations of the earlier stages of their developments. They accuse the anti-GMOs of anti-scientism and thus, utterly unscientific in their standpoint.

Vandana Shiva denies the veracity of the claim that genetic biotechnology is just basically similar and forms part of the 'seamless' continuum with conventional and traditional breeding. She explains that genetic engineering of crops differs significantly from both the traditional and conventional breeding in reference to what she calls 'ecosystem limits' and 'species boundaries'.[102] Ecosystem limits refers to the cultivation of crops according to the adaptability to their natural habitat while species boundaries speak of the development of crops allowing intra-species breeding, maintaining the genetic integrity of the said species. She elaborates that traditional breeding respects both, doing selection of crops within the limits of both the ecosystem and the species. While conventional breeding now taken over by scientists and industries violate the ecosystem boundary yet respects the species boundaries, genetic engineering, she argues, violates both. GM crops are planted everywhere and carry alien genes.

With regard to the accusation against the anti-GMOs for being unscientific in their science-critical thinking, a closer survey of the more recent developments in molecular biology will indicate that such allegation comes from a fundamentally flawed 'scientific' position. Fritjof Capra, a physicist now in the forefront of a new scientific revolution, adopts the complexity or chaos theory[103] in the understanding of the intricate network of life from the perspective of the nonlinear biological processes of living organisms. He has debunked the reductionist and linear interpretative framework of 'genetic determinism', a theory which holds that genes determine biological traits and behavior. This is so, it has been argued, because "genes encode the enzymes that are the necessary catalysts of all cellular processes." Here, there is thus, "a linear causal chain from DNA to RNA, to proteins

[102] "An Interview with Dr. Vandana Shiva", *In Motion Magazine*, 14 August 1998. http://www.inmotionmagazine.com/shiva.html (access: 20/9/03).

[103] To understand the historical development of the emerging science of chaos or complexity theory, see Mitchell Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos* (New York: Simon and Schuster, 1992).

(enzymes) and to biological traits." In this so-called 'Central Dogma of molecular biology' of Francis Crick, the core explanatory concept of biological structure and function is reduced to the gene, metaphorically referred to as the 'program', 'blueprint' or as the 'book of life'. Furthermore, another important assumption is that there could only be "a one-way flow of information from the genes to the proteins, without the possibility of any feedback in the opposite direction."[104]

Referring to the more recent experiments and discoveries in the field of microbiology and the science of genetics and genomics,[105] Capra exposes the weakness and flaws of the 'Central Dogma' of genetic determinism. Adopting the complexity or systems theory as an explanatory scheme, he holds that "biological processes involving genes are regulated by the cellular networks in which genomes are embedded and that the patterns of genetic activity change continually in response to changes in the cellular environment."[106] It is not with the simplistic, linear and reductionist explanation of the genes that we can better understand the dynamics of life but only with a more complex, nonlinear thinking and analysis of the metabolic networks in their multiple pathways within the whole environment. The science of predictability has become more aware of its limits and uncertainty. The Nobel laureate in chemistry, Ilya Prigogine, claims that "[w]e are observing the birth of a new science that is no longer limited by idealized and simplified situations but reflects the complexity of the real world.[107] With such new scientific framework, precautionary principle becomes the more reasonable guide for making decisions regarding technological innovations.

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[104] See Fritjof Capra, *The Hidden Connections: Integrating the Biological, Cognitive and Social Dimensions of Life into a Science of Sustainability* (New York: Doubleday, 2002), 158-206, esp., 169.

[105] The presence of fragmentations in the sequence of the genetic code, the non-coding segments of 'junk DNA', the account of 'jumping genes' in genetic fossil record and the discovery of the complex three-dimensional structure of a protein molecule, among some other data, reveal the complexity of the structure and processes of life, especially in higher organisms. Fritjof Capra, *The Hidden Connections*, 170-171. See also Evelyn Fox Keller, *The Century of the Gene* (Cambridge: Harvard University Press, 2000) and Richard Dawkins, *The Selfish Gene* (New York: Oxford University Press, 1990 [1976]).

[106] Fritjof Capra, *The Hidden Connections*, 193.

[107] See Ilya Prigogine and Isabelle Stengers, *The End of Certainty: Time, Chaos and the New Laws of Nature* (New York: Free Press, 1997), 7. See also Ilya Prigogine and Gregoire Nicolis, *Exploring Complexity: An Introduction* (New York: W. H. Freeman and Co., 1989).

The better option is to have a more respectful attitude that would make us preserve the integrity of creation, a central theme that is articulated in Aldo Leopold's classic environmental insights. He claims that "a thing is right when it tends to preserve the integrity, stability and beauty of the biotic community, and it is wrong when it tends otherwise."[108] Within the holistic ethic of Leopold there is a challenge to preserve the species within the balanced functioning of the ecosystem. James Nash makes a similar assertion by defending what he refers to as the biotic rights of non-human organisms in the ecosystem.[109]

The problem with green biotechnology is that it violates the integrity of well-defined natural entities when it crosses species-boundaries. This happens because it adopts the scientific explanatory model of genetic determinism, believing that genetic improvement and modification can be under full human control. It fails to take into account that many other factors can get into the metabolic processes that may not give the desired results but can cause damage to the complex network of life. Organic farming technology fundamentally respects such complex and multiple pathways of interrelationships (interaction of soil, plants, animals, humans and the total environment) encoded in the cosmic order. Such is the better technology that is based on a more updated and scientific model; one that is better attuned to bring about solutions to our human-made calamities like hunger and poverty in the world. It becomes clearer now that to be scientific is not enough. One needs to be critical of what kind of science operates and whose interest does a particular science or technology serve. "Science for people or science for profit?"[110] What matters more is that we adopt the kind of science that respects the total condition of life - one that is moved by more profound insights and reflections beyond the pure mercantilist consideration

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[108] Aldo Leopold, *A Sand County Almanac* (Oxford: Oxford University Press, 1989 [1949]), 262. Leopold's ideas resonate ecological critics of modern agriculture like Paul B. Thompson, *The Spirit of the Soil: Agriculture and Environmental Ethics* (London: Routledge, 1995).

[109] Nash presents 'A Bill of Biotic Right.' See James A. Nash, *Loving Nature: Ecological Integrity and Christian Responsibility* (Washington D.C.: Abingdon Press, 1991), 186-189.

[110] Allan S. Miller, "Science for People or Science for Profit?" in *Covenant for a New Creation: Ethics, Religion and Public Policy,* eds., Carol Robb and Carl J. Casebolt (New York: Orbis Books, 1991), 63.

of our existence. As our choices are conditioned by our own value system, it is equally imperative that we reflect on the ethical presuppositions behind our fundamental moral options. This we do in the next section.

Evaluation of Ethical Considerations and Presuppositions

In our presentation of the issue of green biotechnology, we have mentioned in different sections some ethical appeals either for or against the introduction of GMOs to agriculture. People surely resort to their own ethical principles and perspectives in trying to reason out what is good for society. Reaching consensus and agreements on issues we debate on may not at all be easy. This is so because our reasoning is derived from different traditions of ethical rationality that is historically conditioned and socially embodied, so MacIntyre argues.[111] Applying this narrative perspective of MacIntyre in agriculture, Comstock claims, "There is no ahistorical Universal Ideal of Good Farming to tell us whose ideal of farming is the true one. Nonetheless, we should realize the historically conditioned nature of all ideals of good farming, including the ideal of tightly linked modern agriculture."[112] Our sense of ideals of a good life is at home with particular root metaphors that define the moral practices and technical strategies with which we pursue such visions. What could be helpful then is to articulate and make open our own ethical presuppositions and appreciate how they function in the debate and whose interest they represent. Gibson Winter provides an initial working scheme to go about understanding the operational root metaphors that underlie our ethical thinking, a framework we can specifically apply in the consideration of the debate on green biotech-

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[111] Alasdair MacIntyre, *After Virtue: A Study in Moral Theory* (London: Duckworth, 1985), 6-22.

[112] Gary L. Comstock, *Vexing Nature?: On the Ethical Case Against Agricultural Biotechnology* (Boston: Kluwer Academic Publishers, 2000), 83. It is interesting to note that Comstock's change of ethical position in his consideration of the issue of biotechnology (from being anti-GMOs in chapters 1-4 to being pro-GMOs in chapters 5-6) goes with the fundamental change of vision.

nology.[113] He speaks of 'metaphor' as a paradigm that can provide us with a coherent vision of the world and a profound meaning of history. Winter speaks about the two main root metaphors - the 'organic metaphor' and the 'mechanistic metaphor' - that have become dominant in the history of Western civilization and which have shaped modes of thought, action, decision and life. Retrieving what he considers as an original dynamic in human evolution (use of tools, language, decoration, ritual, games and myths) via the philosophical discourses of Hans-Georg Gadamer and Paul Ricoeur and the theological explorations of Paul Klee, Winter proposes a third way, i.e., the 'artistic root metaphor'. He believes that the artistic root metaphor can synthesize the strengths and overcome the weaknesses of the first two.[114] We shall elaborate and examine them below and use them as a framework for a meta-ethical evaluation of the debate we have described above.

The Organic Root Metaphor

Serving as a comprehensive worldview of the Western European society from the Middle Ages through the end of the 18th century, according to Winter, the organic root metaphor had the *body* as the fundamental image in understanding the life and dynamics of social organization.[115] Unity, order, cohesion, stability and respect for authority formed part of the fundamental values of the hierarchically structured communities. Conditioned especially by their simple agricultural context, people engaged themselves in productive and economic activities respecting an ordered rhythm of life defined by a seasonal and cyclical perspective of time. The Aristotelian-

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[113] Gibson Winter, *Liberating Creation: Foundations of Religious Social Ethics* (New York: Crossroad, 1981). For a good synthesis of Gibson's theory about the development of root metaphors and its application to green biotechnology, see Darryl L. Birkenfeld, "Deciphering Moral Landscapes in Agricultural Biotechnology," in *The Annual of the Society of Christian Ethics* 17 (1997): 233-250.

[114] For a deeper analysis and clear schematic presentation of Winter's root metaphors, see Jef Van Gerwen, "Root Metaphors of Society: Linking Sociological and Moral-Theological Analysis," *Louvain Studies* XI, 1 (1986): 41-59, esp., 55.

[115] Nisbet traces the beginnings and the evolutions of the organicist metaphor in Western thought to which Winter is indebted. But against Nisbet's thesis, he argues that the mechanicist metaphor has replaced the organicist metaphor in later development of the Western thought. See Robert Nisbet, *Social Change and History: Aspects of the Western Theory of Development* (London: Oxford University, 1972).

Thomistic ethics stood prominent in the moral landscape of the period. What was good and ethical was based on the long-standing community practices that defined the moral standards of a virtuous life. Moreover, such standards were ontologically claimed as corresponding to objective metaphysical reality that could serve as a *telos* of a well-ordered social network.

Winter's description of the organic root metaphor of pre-industrialized Europe can be said to resonate the worldview that remains to be true to a large extent in many developing and heavily agricultural societies. "The image of the earth as living organism and nurturing mother serves as a cultural constraint restricting the actions of human beings."[116] With a sense of deep respect to 'mother earth' of which they are part, people's lives are intertwined within the network of the total cosmic order, i.e., with the land they till, with the crops they cultivate, with the natural world they inhabit and above all, with other humans with whom they belong to as a community. Existence and survival depend a lot on a hierarchical organization of society that ensures the common welfare of that community. Religion, serving as an integrating and legitimizing ethos, functions as an important determiner of social values necessary for strengthening bonds within such social organization.[117]

The Mechanistic Root Metaphor

In highly secularized Western societies, people in general cannot any more relate to the explanatory models of organic metaphor. With the onset of urban mercantilism and industrial capitalism, the organic root metaphor began to fade in the background. The experience and valorization of freedom from the much earlier period, i.e., the Renaissance, unleashed the human potentials for creativity, discovery and inventiveness. The scientific

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[116] Carolyn Merchant, *Radical Ecology: The Search for a Livable World* (New York: Routledge, 1992), 43. Merchant also describes the organic worldview of the pre-modern times in contrast to the mechanistic worldview that has become the legitimating ideology of industrial capitalism since the beginning of modernity.

[117] Emile Durkheim, *The Elementary Forms of the Religious Life*, trans., Joseph Ward Swain (London: George Allen and Unwin, 1915), cited in Keith Roberts, *Religion in Sociological Perspectives* (Belmont, California: Wadsworth Publishing Company, 1990), 4.

revolutions paved the way for the emergence of industrial revolution in the beginning of the 19th century, a period where earlier and further discoveries in science were put at the service of new inventions of modern technologies. Such transformation in the material condition also meant a change in the collective consciousness of peoples in Western societies.[118] People then began to understand the world as a machine, ushering in the birth of a new root metaphor - the mechanistic root metaphor.

If the organic metaphor was more attuned to the metaphysical reality to which the human mind had to humbly surrender in order to take possession of the truth, the mechanistic metaphor believed in the autonomous power of human reason and the mastery of mind over nature. The whole process of modernization sought its own ethical legitimization. The deontological Kantian ethics of right and the utilitarian ethics of the good became the key competing players in the new moral landscape. The first emphasized the autonomy of the individual subject who should be guided by the categorical imperative that could be universally assumed as a sense of duty of the good will. The second scheme understood morality in terms of the consequential benefits that rules (rule utilitarianism) or actions (act utilitarianism) could potentially or actually bring about in the lives of more people in society. In spite of their differences, both modern ethical schemes dismissed any claim of transcendence but valorized the great potential in humanity to control and determine life and history in the world. The shift from a theocentric view to an anthropocentric self-interest, as a result of the radicalization of the autonomy of the subject, had serious repercussions to economic and social conditions.[119] Within the new social arrangement, society's laws began to be derived not from ontological or metaphysical order but from social contracts of free and autonomous moral agents. These formally and positively defined laws that structure social life could be said to be one character of modern 'societies' (*gesellschaft*) that distinguished itself from the agricul-

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[118] Winner describes how 'technology' shapes or misshapes the human spirit. See Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: University of Chicago Press, 1986).

[119] De Tavernier speaks of the loss of theocentric worldview as the most probable reason behind the environmental crisis. See Johan De Tavernier, "Ecology and Ethics," *Louvain Studies* 19 (1994): 235-261, esp., 249.

ture-based social structure of 'communities' (*gemeinschaft*).[120]

Within the new bureaucratic social system that was based on the mechanistic root metaphor, competition, production, domination, development, efficiency and profitability ranked as the most important values. Management had become the main agenda in ensuring the steady progress of society appreciated within the evolutionary and linear concept of time and history. French sociologist Jacques Ellul describes the modern social form as a 'technological society' with *techne* dominating all processes of life.[121] As a consequence, the obsession of gaining technological control of nature legitimized further explorations and exploitation of the earth's resources as well as the continuous subjugation of colonized peoples. Since the focus was given to material development, economy became the defining aspect of life, translating the life-world into a big market where profitability was perceived as the sole measure of success. Technocratic efficiency required compartmentalization and specialization in the field of knowledge and division of labor in the work force. Science and technology became tools in the hands of economic powers that had taken fuller control of the socio-political terrain. This is something that continues to characterize the role of science in contemporary society, observes O'Neill. "The goals of research and development are set not by the internal goals of scientific disciplines themselves, but by the goals of commerce."[122] Ethical and social responsibility is given consideration only insofar as it does not radically go against business concerns and agenda.

The mechanistic root metaphor continues to dominate our contemporary societies. It lies underneath the discourses that support the aggressive application of genetic engineering in agriculture as well as in many other biotechnological applications (e.g., cloning of animals and humans). Life is

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[120] See Ferdinand Tönnies, *Community and Association* (London: Routledge and Kegan Paul, 1955) cited in Francis Fukuyama, *The Great Disruption: Human Nature and the Reconstitution of Social Order* (New York: The Free Press, 1999), 8.

[121] See Jacques Ellul, *The Technological Society*, trans., John Wilkinson (New York: Vintage New York, 1967).

[122] John O'Neill, *Ecology, Policy and Politics: Human Well-being and the Natural World* (London: Routledge, 1993), 157.

understood merely as a machine that can be manipulated and be allowed to function as a mere commodity[123] defined mainly as an economic value according to market mechanisms of the liberal capitalist ideology. Devoid of the transcendental perspective, the system fails to appreciate the sacredness of life, thus, subjecting it to possession and monopoly control of big corporations.[124] With the genetic resources in their hands, agribusinesses take control of food production and distribution. In the process, the homegrown wisdom and technology of farmers is dismissed as unscientific, inferior and meant to be replaced by new scientifically based technology to which these farmers do not have easy and free access. The result is their outright dependence on big agribusiness firms and corporations. The implication of the transition from the organic to mechanistic metaphor is described by Birkenfeld in the following terms: "In the organic society, technology was widely accessible to farmers and cultures constructing their practices through experimentation, cosmological principles and cultural resources; in the mechanistic society, technology became the developmental realm of off-farm academic and administrative 'experts'."[125] Thus, within the umbra of mechanistic metaphor, the small farmers who comprise the majority of the population especially in the South are gradually entrapped in the web of exploitation and disempowerment, made less capable to govern their lives and their productive powers. What results is, what Winter calls, a kind of colonization: "Whether the colonization be political or economic, it expresses the ambition of the techno-society to subject all things to itself."[126] The big businesses that benefit fully from the untested technologies escape responsibilities over unforeseen ill effects, which they then try to solve with new and more dangerous ones.[127]

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[123] See Dorothy Nelkin and Lori Andrews, "Homo Economicus: Commercialization of Body Tissue in the Age of Biotechnology," *Hastings Center Report* 28, no. 5 (1998): 30-39.

[124] Mark J. Hanson, "Religious Voices in Biotechnology: The Case of Gene Patenting," *Hastings Center Report* 27, Special Supplement (1997): 1-21.

[125] Darryl L. Birkenfeld, "Deciphering Moral Landscapes in Agricultural Biotechnology," 41.

[126] Gibson Winter, *Liberating Creation*, 103.

[127] An example is the development of nanotechnology which is now underway. Nanotech is the science and engineering of very small materials and machines in molecular level (with the size of nanometer, unit of measurement that is a billionth of a meter or a thousandth of a micrometer). The National Nanotech Initiative located inside the National Science Foundation (NSF) is now the third largest federal research project in the U.S. See Tim Radford, "Nanotech Moves the Future to a New Level," *The Guardian,* 28 July 2003, 5.

The Artistic Root Metaphor

The 20th century Western society has become the battleground of the ideological clash between the organicist and mechanistic root metaphors. Such dialectical tension paved the way for the emergence of a new root metaphor: the artistic root metaphor which Winter describes as a creative synthesis that emanates from the strength of both while overcoming their destructive potential:

> The aim here is not to displace all other imagery but to relocate these other images in more appropriate places within the authentic processes of human dwelling. Thus, the creativity and self-transcending power of human species life in history and language can be liberated from the oppressive forces of mechanism and the nostalgic yearning for traditional, organic bonds of blood and soil.[128]

The artistic root metaphor combines the creativity of the mechanistic approach with the organicist emphasis on the value of community. It recognizes the importance of the participation of people in the creative endeavors of solving societal problems and improving the condition of life in the world. The most important values within this metaphor include creativity, empowerment, social justice, integrity and care of creation, as well as collaboration and network in the global community. It rests on the fundamental assumption of interdependence among peoples and interconnectedness of humanity and nature. It is through an open and critical process of dialogue in these relationships that truth is achieved. Dogmatic, ideological and totalizing claims are replaced by a deep sensitivity to a revelatory event that opens new horizons and possibilities for creative transformation and participative empowerment. "No longer is order preordained (organic) nor is progress unquestioned and limitless (mechanistic)."[129] The fixed teleology of traditional ethical rationalities, as well as utilitarian and deontological considerations, is allowed to be constantly challenged by new ethical perspectives and wider moral vision. The reality and perspective of the other, those who have been initially excluded and marginalized by the system, could be allowed to contest the assumptions on which the system stands in

[128] Gibson Winter, *Liberating Creation*, 27.
[129] Darryl L. Birkenfeld, "Deciphering Moral Landscapes in Agricultural Biotechnology," 244.

order to constantly break open its totalizing discourses.[130] Hermeneutic enclosures undergo ruptures through new narratives and experiences that subvert long-held presuppositions and give way to the emergence of new liberating metaphors.

Adopting the above metaphor in our thinking about the specific issue of green biotechnology, we see the merits of acknowledging traditional farming methods based on the wisdom of indigenous peoples and communities who have developed them. Any development will have to be genuinely rooted in and appreciative of such a contribution. Yet we do not make an appeal to a nostalgic return to the old approaches in the past that automatically reject modern human creativity that has brought about new discoveries, inventions and knowledge. The contribution of science and technology surely has a place but only insofar as it really promotes life and not destruction, justice and not oppression, equal opportunity and not monopoly control. In this light, therefore, technological improvements in agriculture become acceptable only when they empower the local communities of small farmers in their productive capacities but more importantly, in the way they behold themselves as human beings with great dignity and responsibility for the whole creation. Acknowledging this appeal articulated in environmental protest movements, Northcott holds that "the devolution of economic and political power from corporations and nation-states to local communities are all suggestive of a new localized vision of human self-government and the common weal which can effectively challenge the subversion of both human and environmental goods by the faceless power of technological processes."[131] Yet, he adds that what should go with that is a radical change of heart, of orientation, from the wasteful and intemperate surfeit of consumerism and the technologies which drive the throw-away society, to a simpler style of life involving fulfillment through patterns of artifact pro-

[130] Enrique Dussel develops in his liberation ethics the anadialectical scheme influenced by Emmanuel Levinas' ethical concept of the 'other'. Dussel speaks of the other as historically and socially embodied in the poor who are marginalized, excluded and oppressed by the dominant system. See Enrique Dussel, É*tica de la liberación en la edad de la globalización y de la exclusión* (Mexico: Editorial Trotta, 1998).

[131] See Michael Northcott, *The Environment and Christian Ethics, New Studies in Christian Ethics* (Cambridge: Cambridge University Press, 1996), 308.

duction and consumption, work and play which consume less energy and fewer natural resources."[132] The challenge is to develop a more responsible and reflexive approach that considers the totality and complexity of life within the whole network of relationships: of the present with the past (wisdom) and the future (sustainability); of a particular people (local) with all the others in the globe (global); and of humanity with the whole of creation (beyond anthropocentrism). Without these considerations, any utilitarian or even deontological claim of solving the problem of world hunger and poverty will only lead to further dehumanization and marginalization of those who are already buried in misery.

Conclusion

Can transgenic crops and food be a real solution to world hunger? The above investigation has exposed the weakness of this proposition in many respects. First, we have argued that such assumption is based on a false analysis of the real causes of hunger and poverty in the world. It is not the lack of food for the increasing world population but the incapacity of many to have access to earth's basic goods and resources that provides one explanatory key to worldwide hunger. The unequal distribution and unjust economic relations that characterize the global dominant system of capitalist liberal ideology further widens the gap between the rich and the poor, leaving little or no food on the dining table of the starving millions of the world's most deprived populations. We have seen that green biotechnology which is being presented with humanitarian overtones are presently in the hands of multinational companies whose primary value is profit and whose logic is monopoly control. Given this present context and circumstances that revolve around the introduction of biotechnology in agriculture, we have expressed our opposition against such propaganda in the ideological terrain of political economy. We make an appeal instead for a certain development in agriculture that genuinely promotes not only food security but more so, food sovereignty.

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[132] Ibid.

Second, we have raised questions against transgenic crops in view of safety both for human health and the environment. With concrete evidence, solid argumentation and appropriate scientific framework which experts offer us in the consideration of green biotechnology, we have seen the dangers and risks that jeopardize our future in terms of the sustainability of life within the integral and complex network of relationships in the biosphere. This means therefore that what is being proposed is not a solution but a complication of the problem that may offer no further way out in the uncertain future. Organic farming has offered a more promising technology that recognizes the ingenuity and wisdom of agricultural communities for centuries; it critically appropriates the new discoveries of the recent past; and ensures the sustainability of life in the future.

Third and most importantly, we have tried to examine the presuppositions that lie underneath many of our ethical assumptions that legitimize our claims and rationalizations. We tried to do so by understanding the root metaphors that determine people's worldviews and vision of reality in the world as well as new metaphors that have the power to break open hermeneutic enclosures in people who are 'desensitized' in the comfort zones of anthropocentric self-interest and individualistic existence under the spell of an ideological system of liberal capitalist and mechanistic persuasions. We have adopted the artistic metaphor that provides an opening and a space for the liberating perspective that comes from the other, the excluded and oppressed of the system.

To conclude, we can therefore say that the reality of world hunger is such a complex issue and its solution does not definitely depend on technology quick-fix formula; rather, it requires a more profound critical analysis of its causes. Failure to do so would lead us down the road of further frustration, if not utter self-destruction. Considering that the real problem of hunger underlies our socio-economic, political and cultural network of relationships, we can safely assert that the solution ultimately depends on the change of minds (perspectives, worldviews and root metaphors), of hearts (openness, sensitivity, justice and love for the other) and of our lifestyle and habits (in consumption). Only when the values of altruism, responsibility, respect and care of the other (which includes the totality of creation) permeate our socio-economic and political structures, can creative technologies

which emerge from such a new disposition be put at the genuine service of humanity and of the whole biosphere. When all of these begin to form part of our system of values and relationships, we can truly be optimistic and hopeful that safe and healthy food will eventually be sufficiently made available on the dining table of the poor, leaving nobody hungry. Yes, there is hope as long as we take part in the building of a new world order.

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