Conclusion: The Future of GM Food

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The essays in this volume were written by more than fifty scientists and public policy experts, whose analyses of GMOs represent many disciplines and public interest perspectives. If we add to their voices the viewpoints of the references they cite, we have literally hundreds of commentaries that bear witness to the deceptions associated with the promoters of GMOs. The real and potentially adverse effects of GMOs have been understated or negated by government and corporations, neglected by the press, and ignored by many in the scientific community who accept uncritically a corporate-crafted message. A fair-minded and unbiased individual looking at all the evidence must reach the conclusion that there is a great deal we do not know and what we do know impels us to be both cautious and concerned, skeptical of an early manufactured consensus, and critical of a framing that fails to recognize the diversity of public objections to GMOS. What follows are the key findings in this volume that support the premise behind "The GMO Deception."

Imprecision

Notwithstanding the claims of the biotechnology industry, plant and animal genetic engineering is not a precise science. Indeed, claims of the precision science of gene splicing represent an outdated view that has long been discredited by credible scientists of human biology and yet continues to be stubbornly advanced by special interests.[1] The genome of plant seeds and animals are not like a set of Legos where biotechnicians can plug in or delete genetic components with great precision. These genomes are more likened to ecosystems where one change in a gene can induce unpredictable changes in the other parts of the system. The only way to know what properties have been changed in the organism is to test each and every product created for a variety of traits. Anyone who claims, "Trust us,

we know exactly how the organism will be changing" is deceiving the public. As Dr. Fagan notes in his primer on DNA:

> the GMO gene must enter the nucleus of the cell. Then, once it's in the nucleus, at some low frequency, it becomes inserted into the cell's own DNA. Scientists do not understand the mechanism by which the DNA insertion process occurs, and they have no control over it. This is the big problem because these mutations can give rise to unintended, unexpected damage to the functioning of the organism.

The imprecision and unintended effects inherent to GMO technology necessitate testing GMO products for health and environmental effects before they are introduced into the food supply. Otherwise the burden of assessing risk is shifted from corporations and government regulators to consumers.

Evidence of Potential Harm to Consumers

There is *prima facie* evidence from animal studies of potential harm from some GMO products. This evidence appears in peer-reviewed publications by independent investigators who stand to make no financial gain from reaching these conclusions. The experiments that show adverse effects on animals include those published by Árpád Pusztai on genetically modified potatoes,[2] Gilles-Eric Séralini on genetically modified maize[3], and Malatesta et al on genetically modified soybean.[4] In 2008, the latter group found that GM soybean intake can influence some liver functions during ageing and that senescence pathways are significantly activated in GM-fed mice. The authors emphasize the importance of investigating the long-term consequences of GM-diets and the potential synergistic effects with ageing.[5]

In 2009 de Vendomois et al. fed rats three commercialized GM maize varieties and found newly observed side effects with the kidney and liver and other effects observed in the heart, adrenal glands, spleen, and blood (hemato-poietic) system.[6] In the same year another group of researchers fed transgenic and organic soy to rats. The GMO soy altered the ovulation cycle of the rat compared to organic soy or non-soy diets. They also observed increased cell growth in the uterus for rats fed with GMO soy.[7] Rabbits fed GM soya-bean

meal exhibited significant differences in enzyme levels in three organs from GM-fed rabbits.[8]

There have been dozens of animal feeding studies of GMOs. Most of them have not shown adverse effects.[9] But without a systematic testing program overseen by a federal agency, the public must take seriously a dozen or so animal studies that do show adverse effects. In the field of science, negative findings to a widely held view that a substance is safe are more important than studies that show no adverse effects. These negative findings must be pursued to ascertain if they stand up to replication and if those findings on animal models can be extrapolated to humans. Additional long-term studies are also required. Assurances that GMOs are safe cannot be considered compelling in the absence of further study. Instead, what we have seen are ad hominem corporate-sponsored attacks on those few scientists who have engaged in such studies and reported concerns.

Ecological Harm

A number of actual and potential ecological impacts of GMOs have been identified. Evidence for some of these impacts has been published. Other potential impacts remain possibilities and have not been adequately tested in field studies. We will focus on those impacts cited in this volume for which there is evidence of GMO-induced ecological harm.

GMO seeds that are resistant to the herbicide glyphosate are pervasively being used, displacing traditional varieties of non-GMO seeds and exposing greater acreages in the United States to the herbicide glyphosate.[10] According to the widely cited study by Charles Benbrook, "Herbicide-resistant crop technology has led to a 239 million kilogram (527 million pound) increase in herbicide use in the United States between 1996 and 2011, while Bt crops have reduced insecticide applications by 56 million kilograms (123 million pounds). Overall, pesticide use increased by an estimated 183 million kgs (404 million pounds), or about 7 percent."[11] The expanded use of the herbicide has reduced the amount of milkweed plants. Milkweed is the one food source for Monarch butterflies. The decline of Monarchs has been, in part, caused by the introduction of GMO glyphosate resistant seeds.[12]

Through pollen drift, GMOs have been shown to have contaminated organic farms. Once an organic farm has been contaminated by GMO pollen

it can take years for the farm to be re-accredited as organic. Not only have companies like Monsanto been able to avoid paying damages for such contamination by its seeds, they have actually sued the farmers/victims for patent infringement.

Although widely touted as "green technology" the most credible evidence to date is that GMOs are more chemically dependent than conventional seeds. That's what "Round-up Ready" means—ready for the herbicide. Indeed, GMOs are actually falling behind productivity improvements in more traditional breeding and crop production methods while continuing to reinforce the spread of industrial monoculture. As noted by Gurian-Sherman in this volume, "Monocultures are contrary to agro-ecologically sound farming systems based on crop and ecosystem diversity."

Impact on Small Farmers

GMO technologies have introduced a new form of dependency of small farmers to seed manufacturers. They have become transformed into serfs—workers who must buy their seeds under contract and who are restrained under patent protections from exchanging seeds with other farmers, submitting the seeds for scientific testing, or saving the seeds for the next season. Indian farmers opposed the introduction of Bt brinjal because of its disruption of locally controlled seed trading and because of fears that the GMO product would alter the metabolism of the plant, which has been widely used in alternative medicine for its medicinal properties. Also in India, the use of herbicide tolerant crops has displaced workers who do the weeding, which is an important income source in rural areas. Transnational companies like Monsanto have no concerns about rural labor in developing countries. Often, rural farmers in a developing world are part of an agro-political economy that includes government programs, banks, and international organizations that force them to adopt the latest GMO seed, while making conventional varieties unavailable.

In this volume Dr. Mira Shiva reports that for Indian farmers the price of cotton seeds rose astronomically, five hundred times what they used to pay for conventional seed, half of which was in royalty payments. This resulted in indebtedness and, according to some observers, drove some farmers to suicide. Too often, top-down agricultural policies are specifically designed to maximize

corporate profits at the expense of the actual needs of local populations. To succeed, any solution must empower citizens to define their own agricultural management system unrestricted by intellectual property rights and GM patents.

Alteration of the Allergenicity and Immunigenicity of Plants

It is already known from laboratory experiments that transgenes can alter the allergenicity and immunogenicity of a plant in unexpected ways.[13] When a pea plant was genetically modified with genes from the common bean to protect it from insects, the GMO peas caused an immune response in mice that could elicit inflammatory reactions.[14] Unless every GMO plant that is grown can be shown to be free of allergenic and immunogenic effects and their genomes are stable, the laboratory evidence is suggestive of increasing effects on human allergenicity. Food allergies are a growing food safety and public health concern that affect an estimated 4 to 6 percent of children in the United States.[15] Allergic reactions to foods can be life threatening and have far-reaching effects on children and their families. Without systematic testing, we will never know until it is too late.

Rise of Insect and Weed Resistance

Every responsible ecologist knows that if you overuse an insect toxin or an herbicide the result will be an increase in insect and herbicide resistance. We have faced a similar effect in the overuse of antibiotics. The same antibiotics used to offset human infection are used in animals to prevent infection. As a consequence, we have seen the rise of antibiotic resistance genes spread throughout human societies. The purveyors of GMOs are not supporting Integrated Pest Management strategies that would reduce the rise of resistant weeds and insects.

Addressing World Hunger

One of the monumental and continuous deceptions of GMOs is that it represents a miracle technology that will reduce world hunger and increase food security across the poorest nations. In reality, social, political, and economic factors must first be addressed in order to ensure food access and appropriate development. A process that was intended to provide a vision for how agriculture will meet the needs of the world's 850 million poorest over the next fifty years

was initiated through the International Assessment of Agricultural Science and Technology for Development (IAASTD). Launched in 2005 under the auspices of five United Nations agencies, the World Bank, and the World Health Organization, the IAAST 2007 report could find little if any major contribution to food security and world hunger from GMOs and little potential to do so.

Forbidden Labels

We have labels for all sorts of food choices including additives, fishing methods (dolphin-free tuna), types of fat, foreign proteins (except when they are incorporated into the plant genome), animal care (free range), or types of agriculture (organically grown). Food is even labeled by where it is grown. One of the great American corporate deceptions is that the public does not have a reason to require the labeling of genetically adulterated food. Every person has a right to be the first, last, or non-user of a new technology. Yet with GAUF—genetically adulterated unlabeled food—this is a right that has been kept from the American consumer. The government argument is that if the food looks, feels, and tastes like its non-GMO counterpart, then it is "substantially equivalent" and should not be labeled. This rationale has no scientific basis and was imposed on consumers by an industry that did not wish consumers to know how their food was created.

Climate Change and Sustainable Agriculture

There is no credible evidence that GMOs have contributed to a sustainable agriculture or to reducing the carbon footprint of food production. The general consensus of the authors in this volume is that GMOs are responsible for increasing chemical inputs since they are tied to the seeds. Most of the gains in drought resistance have come through traditional breeding, agronomy, and ecological agricultural practices, and not GMOs. Dozens of articles have been published about the effect of glyphosate on animals and plants. With GMOs, glyphosate use has become ubiquitous. Findings in the scientific literature are disturbing: glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines; glyphosate induces carcinogenicity in mouse skin, it provokes cell division dysfunction, causes teratogenic effects on vertebrates, and produces adverse effects on human placental cells. In the absence of evidence that genetically modified foods are cheaper, produce greater yields, or even work

particularly well lies one widely recognized conclusion: GMO foods provide no added nutritional or cost benefit to the consumer.

This book is trying to set the record straight on GMOs. There is no scientific consensus on the safety and agricultural value of GM crops. We cannot accept the argument that because millions of people have eaten GMOs on their dinner plates then they must be safe. Sometimes it takes years and focused research programs to uncover the hazards of products that have become commonplace. DDT, PCBs, asbestos, tobacco, lead, and benzene are just a few examples of products that were marketed for decades before their danger to human health was documented. As more and more crops and processed foods containing GMOs find their way onto supermarket shelves, the public is justified in demanding a full and transparent investigation. Without one, the GMO Deception will continue unabated.