The Case for A GM-Free Sustainable World
By Institute of Science in Society
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Why GM Free?

1. GM crops failed to deliver promised benefits - The consistent finding from independe esearch and on-farm surveys since 1999 is that GM crops have failed to deliver the promised benefits of significantly increasing yields or reducing herbicide and pesticide use. GM crops have cost the United States an estimated $12 billion in farm subsidies, lost sales and product recalls due to transgenic contamination. Massive failures in Bt cotton of up to 100% were reported in India.

Biotech corporations have suffered rapid decline since 2000, and investment advisors forecast no future for the agricultural sector. Meanwhile worldwide resistance to GM has reached a climax in 2002 when Zambia refused GM maize in food aid despite the threat of famine.

2. GM crops posing escalating problems on the farm - The instability of transgenic lines has plagued the industry from the beginning, and this may be responsible for a string of major crop failures. A review in 1994 stated, "While there are some examples of plants which show stable expression of a transgene these may prove to be the exceptions to the rule. In an informal survey of over 30 companies involved in the commercialisation of transgenic crop plants….almost all of the respondents indicated that they had observed some level of transgene inaction. Many respondents indicated that most cases of transgene inactivation never reach the literature."

Triple herbicide-tolerant oilseed rape volunteers that have combined transgenic and non-transgenic traits are now widespread in Canada. Similar multiple herbicide-tolerant volunteers and weeds have emerged in the United States. In the United States, glyphosate-tolerant weeds are plaguing GM cotton and soya fields, and atrazine, one of the most toxic herbicides, has had to be used with glufosinate-tolerant GM maize.

Bt biopesticide traits are simultaneously threatening to create superweeds and Bt- resistant pests.

3. Extensive transgenic contamination unavoidable - Extensive transgenic contamination has occurred in maize landraces growing in remote regions in Mexico despite an official moratorium that has been in place since 1998. High levels of contamination have since been found in Canada. In a test of 33 certified seed stocks, 32 were found contaminated.

New research shows that transgenic pollen, wind-blown and deposited elsewhere, or fallen directly to the ground, is a major source of transgenic contamination. Contamination is generally acknowledged to be unavoidable, hence *there can be no co-existence of transgenic and non-transgenic crops*.

4. GM crops not safe - Contrary to the claims of proponents, GM crops have not been proven safe. The regulatory framework was fatally flawed from the start. It was based on an *anti*-precautionary approach designed to expedite product approval at the expense of safety considerations. The principle of 'substantial equivalence', on which risk assessment is based, is intended to be vague and ill-defined, thereby giving companies complete licence in claiming transgenic products 'substantially equivalent' to non-transgenic products, and hence 'safe'.

5. GM food raises serious safety concerns - There have been very few credible studies on GM food safety. Nevertheless, the available findings already give cause for concern. In the still only systematic investigation on GM food ever carried out in the world, 'growth factor-like' effects were found in the stomach and small intestine of young rats that were not fully accounted for by the transgene product, and were hence attributable to the transgenic process or the transgenic construct, *and may hence be general to all GM food*. There have been at least two other, more limited, studies that also raised serious safety concerns.

6. Dangerous gene products are incorporated into crops - Bt proteins, incorporated into 25% of all transgenic crops worldwide, have been found harmful to a range of non-target insects. Some of them are also potent immunogens and allergens. A team of scientists have cautioned against releasing Bt crops for human use.

Food crops are increasingly used to produce pharmaceuticals and drugs, including cytokines known to suppress the immune system, induce sickness and central nervous system toxicity; interferon alpha, reported to cause dementia, neurotoxicity and mood and cognitive side effects; vaccines; and viral sequences such as the 'spike' protein gene of the pig coronavirus, in the same family as the SARS virus linked to the current epidemic. The glycoprotein gene *gp120* of the AIDS virus HIV-1, incorporated into GM maize as a 'cheap, edible oral vaccine', serves as yet another biological time-bomb, as it can interfere with the immune system and recombine with viruses and bacteria to generate new and unpredictable pathogens.

7. Terminator crops spread male sterility - Crops engineered with 'suicide' genes for male sterility have been promoted as a means of 'containing', i.e., preventing, the spread of transgenes. In reality, the hybrid crops sold to farmers spread both male sterile suicide genes as well herbicide tolerance genes *via pollen.*

8. Broad-spectrum herbicides highly toxic to humans and other species - Glufosinate ammonium and glyphosate are used with the herbicide-tolerant transgenic crops that currently account for 75% of all transgenic crops worldwide. Both are systemic metabolic poisons expected to have a wide range of harmful effects, and these have been confirmed.

Glufosinate ammonium is linked to neurological, respiratory, gastrointestinal and haematological toxicities, and birth defects in humans and mammals. It is toxic to butterflies and a number of beneficial insects, also to the larvae of clams and oysters, *Daphnia* and some freshwater fish, especially the rainbow trout. It inhibits beneficial soil bacteria and fungi, especially those that fix nitrogen.

Glyphosate is the most frequent cause of complaints and poisoning in the UK. Disturbances of many body functions have been reported after exposures at normal use levels.

Glyphosate exposure nearly doubled the risk of late spontaneous abortion, and children born to users of glyphosate had elevated neurobehavioral defects. Glyphosate caused retarded development of the foetal skeleton in laboratory rats. Glyphosate inhibits the synthesis of steroids, and is genotoxic in mammals, fish and frogs. Field dose exposure of earthworms caused at least 50 percent mortality and significant intestinal damage among surviving worms. Roundup caused cell division dysfunction that may be linked to human cancers.

The known effects of both glufosinate and glyphosate are sufficiently serious for all further uses of the herbicides to be halted.

9. Genetic engineering creates super-viruses - By far the most insidious dangers of genetic engineering are inherent to the process itself, which greatly enhances the scope and probability of horizontal gene transfer and recombination, the main route to creating viruses and bacteria that cause disease epidemics. This was highlighted, in 2001, by the 'accidental' creation of a killer mouse virus in the course of an apparently innocent genetic engineering experiment.

Newer techniques, such as DNA shuffling are allowing geneticists to create in a matter of minutes in the laboratory millions of recombinant viruses that have never existed in billions of years of evolution. Disease-causing viruses and bacteria and their genetic material are the predominant materials and tools for genetic engineering, as much as for the intentional creation of bio-weapons.

10. Transgenic DNA in food taken up by bacteria in human gut - There is already experimental evidence that transgenic DNA from plants has been taken up by bacteria in the soil and in the gut of human volunteers. Antibiotic resistance marker genes can spread from transgenic food to pathogenic bacteria, making infections very difficult to treat.

11. Transgenic DNA and cancer - Transgenic DNA is known to survive digestion in the gut and to jump into the genome of mammalian cells, raising the possibility for triggering cancer.

The possibility cannot be excluded that feeding GM products such as maize to animals also carries risks, not just for the animals but also for human beings consuming the animal products.

12. CaMV 35S promoter increases horizontal gene transfer - Evidence suggests that transgenic constructs with the CaMV 35S promoter might be especially unstable and prone to horizontal gene transfer and recombination, with all the attendant hazards: gene mutations due to random insertion, cancer, reactivation of dormant viruses and generation of new viruses. This promoter is present in most GM crops being grown commercially today.

13. A history of misrepresentation and suppression of scientific evidence - There has been a history of misrepresentation and suppression of scientific evidence, especially on horizontal gene transfer. Key experiments failed to be performed, or were performed badly and then misrepresented. Many experiments were not followed up, including investigations on whether the CaMV 35S promoter is responsible for the 'growth-factor-like' effects observed in young rats fed GM potatoes.

In conclusion, GM crops have failed to deliver the promised benefits and are posing escalating problems on the farm. Transgenic contamination is now widely acknowledged to be unavoidable, and hence there can be no co-existence of GM and non-GM agriculture. Most important of all, GM crops have not been proven safe. On the contrary, sufficient evidence has emerged to raise serious safety concerns, that if ignored could result in irreversible damage to health and the environment. GM crops should be firmly rejected now.

Why Sustainable Agriculture?

1. Higher productivity and yields, especially in the Third World - Some 8.98 million farmers have adopted sustainable agriculture practices on 28.92 million hectares in Asia, Latin America and Africa. Reliable data from 89 projects show higher productivity and yields: 50-100% increase in yield for rainfed crops, and 5-10% for irrigated crops. Top successes include Burkina Faso, which turned a cereal deficit of 644 kg per year to an annual surplus of 153 kg; Ethiopia, where 12 500 households enjoyed 60% increase in crop yields; and Honduras and Guatemala, where 45 000 families increased yields from 400-600 kg/ha to 2 000-2 500 kg/ha.

Long-term studies in industrialised countries show yields for organic comparable to conventional agriculture, and sometimes higher.

2. Better soils - Sustainable agricultural practices tend to reduce soil erosion, as well as improve soil physical structure and water-holding capacity, which are crucial in averting crop failures during periods of drought.

Soil fertility is maintained or increased by various sustainable agriculture practices. Studies show that soil organic matter and nitrogen levels are higher in organic than in conventional fields.

Biological activity has also been found to be higher in organic soils. There are more earthworms, arthropods, mycorrhizal and other fungi, and micro-organisms, all of which are beneficial for nutrient recycling and suppression of disease.

3. Cleaner environment - There is little or no polluting chemical-input with sustainable agriculture. Moreover, research suggests that less nitrate and phosphorus are leached to groundwater from organic soils.

Better water infiltration rates are found in organic systems. Therefore, they are less prone to erosion and less likely to contribute to water pollution from surface runoff.

4. Reduced pesticides and no increase in pests - Organic farming prohibits routine pesticide application. Integrated pest management has cut the number of pesticide sprays in Vietnam from 3.4 to one per season, in Sri Lanka from 2.9 to 0.5 per season, and in Indonesia from 2.9 to 1.1 per season.

Research showed no increase in crop losses due to pest damage, despite the withdrawal of synthetic insecticides in Californian tomato production.

Pest control is achievable without pesticides, reversing crop losses, as for example, by using 'trap crops' to attract stem borer, a major pest in East Africa. Other benefits of avoiding pesticides arise from utilising the complex inter-relationships between species in an ecosystem.

5. Supporting biodiversity and using diversity - Sustainable agriculture promotes agricultural biodiversity, which is crucial for food security and rural livelihoods. Organic farming can also support much greater biodiversity, benefiting species that have significantly declined.

Biodiverse systems are more productive than monocultures. Integrated farming systems in Cuba are 1.45 to 2.82 times more productive than monocultures. Thousands of Chinese rice farmers have doubled yields and nearly eliminated the most devastating disease simply by mixed planting of two varieties.

Soil biodiversity is enhanced by organic practices, bringing beneficial effects such as recovery and rehabilitation of degraded soils, improved soil structure and water infiltration.

6. Environmentally and economically sustainable - Research on apple production systems ranked the organic system first in environmental and economic sustainability, the integrated system second and the conventional system last. Organic apples were most profitable due to price premiums, quicker investment return and fast recovery of costs.

A Europe-wide study showed that organic farming performs better than conventional farming in the majority of environmental indicators. A review by the Food and Agriculture Organization of the United Nations (FAO) concluded that well-managed organic agriculture leads to more favourable conditions at all environmental levels.

7. Ameliorating climate change by reducing direct & indirect energy use - Organic agriculture uses energy much more efficiently and greatly reduces CO_2 emissions compared with conventional agriculture, both with respect to direct energy consumption in fuel and oil and indirect consumption in synthetic fertilizers and pesticides.

Sustainable agriculture restores soil organic matter content, increasing carbon sequestration below ground, thereby recovering an important carbon sink. Organic systems have shown significant ability to absorb and retain carbon, raising the possibility that sustainable agriculture practices can help reduce the impact of global warming.

Organic agriculture is likely to emit less nitrous dioxide (N_2O), another important greenhouse gas and also a cause of stratospheric ozone depletion.

8. Efficient, profitable production - Any yield reduction in organic agriculture is more than offset by ecological and efficiency gains. Research has shown that the organic approach can be commercially viable in the long-term, producing more food per unit of energy or resources.

Data show that smaller farms produce far more per unit area than the larger farms characteristic of conventional farming. Though the yield per unit area of one crop may be lower on a small farm than on a large monoculture, the total output per unit area, often composed of more than a dozen crops and various animal products, can be far higher.

Production costs for organic farming are often lower than for conventional farming, bringing equivalent or higher net returns even without organic price premiums. When price premiums are factored in, organic systems are almost always more profitable.

9. Improved food security and benefits to local communities - A review of sustainable agriculture projects in developing countries showed that average food production per household increased by 1.71 tonnes per year (up 73%) for 4.42 million farmers on 3.58 million hectares, bringing food security and health benefits to local communities.

Increasing agricultural productivity has been shown to also increase food supplies and raise incomes, thereby reducing poverty, increasing access to food, reducing malnutrition and improving health and livelihoods.

Sustainable agricultural approaches draw extensively on traditional and indigenous knowledge, and place emphasis on the farmers' experience and innovation. This thereby utilises appropriate, low-cost and readily available local resources as well as improves farmers' status and autonomy, enhancing social and cultural relations within local communities. Local means of sale and distribution can generate more money for the local economy. For every £1 spent at an organic box scheme from Cusgarne Organics (UK), £2.59 is generated for the local economy; but for every £1 spent at a supermarket, only £1.40 is generated for the local economy.

10. Better food quality for health - Organic food is safer, as organic farming prohibits routine pesticide and herbicide use, so harmful chemical residues are rarely found. Organic production also bans the use of artificial food additives such as hydrogenated fats, phosphoric acid, aspartame and monosodium glutamate, which have been linked to health problems as diverse as heart disease, osteoporosis, migraines and hyperactivity. Studies have shown that, on average, organic food has higher vitamin C, higher mineral levels and higher plant phenolics – plant compounds that can fight cancer and heart disease, and combat age-related neurological dysfunctions – and significantly less nitrates, a toxic compound.

Sustainable agricultural practices have proven beneficial in all aspects relevant to health and the environment. In addition, they bring food security and social and cultural well-being to local communities everywhere. There is an urgent need for a comprehensive global shift to all forms of sustainable agriculture.