



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

## **Eyes Wide Shut!**

**Beris Gwynne & Parmjeet Binning**

*Paper prepared for presentation at the “Food for the Future: Opportunities for a Crowded Planet” conference conducted by the Crawford Fund for International Agricultural Research, Parliament House, Canberra, Australia, August 8, 2002*

*Copyright 2002 by Beris Gwynne & Parmjeet Binning. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.*



## Eyes Wide Shut!

*The ethical dilemmas posed by the promotion of new-generation genetically modified organisms (GMOs) as a solution to world hunger*

**BERIS GWYNNE AND PARMJEET BINNING**

Eight hundred million of the world's 6 billion people don't have access to adequate nutrition. With world population expected to peak at 7–8 billion within a generation, mostly in developing countries, and with environmental degradation and future water shortages to consider, pressure is on to find ways to improve food security. The question is whether GMOs offer the best prospects of improved food security for the world's hungry within the context of sustainable development and limited resources.

Progress on a number of other fronts holds more promise than GMOs. Nobel Prize-winning economist Amartya Sen has argued that the problem is one of food distribution, not supply. To these, add the ongoing debate about levels of agricultural subsidies in first-world countries and their impact on food production in developing countries, the disequilibrium in resources applied to first-world research interests documented by Harvard-based economist Jeffrey Sachs, and declining levels of assistance to support application of existing knowledge in the developing world.

Whilst the pursuit of global food security within the context of sustainable development is an objective with undeniably widespread support, views on the potential contribution of GMOs are extremely polarised, reflecting a lack of reliable information and concern about ethical, ecological, socio-economic, legal, public health, food safety, and inter-generational equity dimensions.

There is urgent need for effective policy dialogue and regulatory frameworks that separate the hype from the reality, and ensure that the advancement of food security and sustainable development are truly the primary goals.

**Each day our world witnesses 800 million people go hungry and 170 million children under five years of age suffer from malnourishment. This situation is a human tragedy on a vast scale, made even worse because it is avoidable** (International Food Policy Research Institute 2002).

### Introduction

To the extent that a large proportion of the world's six billion people do not have access to adequate nutrition, the pursuit of global food security is unarguably an objective of major

Ms BERIS GWYNNE was appointed Executive Director of The Foundation for Development Cooperation in Brisbane in May 2000. Prior to her appointment to FDC, she served as a diplomat with the Australian Department of Foreign Affairs and Trade in diplomatic missions in Vietnam, Poland, Mexico and Nauru. She joined the Australian Agency for International Development (AusAID) in 1989 and worked there until 1994 when she was appointed Group Executive for International and Indigenous Programs for World Vision Australia (WVA).

significance. In an increasingly integrated and interdependent world, food security is more than a humanitarian or moral imperative. It has far-reaching security, socio-economic, and environmental implications. Scientific and technological developments that can dramatically advance prospects of achieving global food security and sustainable development are extremely exciting; but it is of vital importance that implications of new technologies be thoroughly examined.

*'Important decisions impacting upon public health and safety, the environment, as well as the social and economic benefit to civil society, all hinge on the honesty of scientists and the*

*reliability of scientific advice given ... and the debate must be conducted in terms comprehensible to the general public so that the public can participate in making decisions. Science is an active knowledge system, and uncertainty is its hallmark. Judgements are invariably based on incomplete information, and that is where precaution must be the guiding principle'. (Ho 2001).*

This paper explores the various ethical dilemmas related to the promotion of genetically modified organisms (GMOs) as offering best prospects for the advancement of food security and sustainable development objectives. It argues that genetic engineering technologies 'must be put into perspective' as 'the same goals may be achieved using traditional methods and sources of technology' (Babcock and Francis 2000). It concludes that, where the ultimate objectives are food security and sustainable and equitable development, progress on a number of other political, economic, and social levels may be more effective and less risky.

## Scope and definitions

### **Sustainable development**

The Brundtland Commission defined sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Cross 2002). The principle of sustainable development has been widely supported by the international community, albeit with support for the 1992 *Rio Declaration* on the wane if preparations for the World Summit on Sustainable Development in Johannesburg are any indication. The Council of Australian Governments adopted the principle ten years ago. Major life science corporations, such as Monsanto and Du Pont, have also pledged their commitment to the principle of sustainable development.<sup>7</sup> Mining magnate Hugh Morgan was recently quoted as saying that sustainable development was a necessity, not an option.

<sup>7</sup> See for example:

[http://www.monsanto.com/monsanto/about\\_us/monsanto\\_pledge/default.htm](http://www.monsanto.com/monsanto/about_us/monsanto_pledge/default.htm) ; and

[http://www.dupont.com/corp/news/position/sustainable\\_dev.html](http://www.dupont.com/corp/news/position/sustainable_dev.html)

### **Food security**

In 1948 'food security' was recognised as a fundamental human right by the Panel of Eminent Experts on Ethics in Food and Agriculture. It is instructive to note, however, that the United States government reversed its support for this position at the 1996 World Food Summit. Food security is a multi-dimensional concept. In essence, the United Nations Committee on Economic, Social and Cultural Rights has defined the right as:

*'the availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals, free from adverse substances and acceptable within a given culture; the accessibility of such food in ways that are sustainable and that do not interfere with the enjoyment of other human rights'* (Food and Agriculture Organisation of the United Nations 2001b).

### **Genetically modified organisms (GMOs)**

Stephen Nottingham (2002) notes that *'by the year 2000, there were 44 million hectares of transgenic crops world wide. Transgenic micro-organisms, trees and fish are also being released into the environment. He asks if 'sufficient attention has been paid to the environmental costs, in the face of evidence of genetic contamination, and threats to non-target species, agricultural diversity and the rights of small farmers'*.

Biotechnology is a broad term that applies to all practical uses of living organisms. The scope of biotechnology has expanded radically over the past century. There are two main categories of biotechnologies: traditional biotechnologies and new biotechnologies. The selective breeding of plants and animals is perhaps the best demonstration of traditional biotechnologies. Unlike the new biotechnologies, this process operates on *whole* organisms, and not a small number of gene transfers.

New biotechnologies, on the other hand, are more revolutionary, involving transfer of genetic material, sometimes from totally unrelated species. The new biotechnologies can be divided into those that cannot affect future generations, and those that can. The latter are known as

genetic engineering technologies. The key defining feature of genetic engineering technologies relates to the capacity of this new technology to transfer genes horizontally between species that do not inter-breed. This unprecedented ability to shuffle genes means that genetic engineers are able to make combinations of genes not found in nature. This characteristic on its own triggers substantial debate on theological and bio-ethical lines with religious and other groups protesting human interference in the natural order.

While there is a wide variety of applications of genetic engineering technologies, such as medicinal and industrial, this paper examines the application of GMOs in agriculture, and specifically their contribution towards the attainment of global food security and sustainable development; and the ethical dilemmas generated by their inclusion among the menu of available options.

## **Ethics**

*'In a civilised life, law floats in a sea of ethics'* - Earl Warren 1891–1974 US Chief Justice

Donald A. Brown, Director of the Pennsylvania Consortium for Interdisciplinary Environmental Policy, recently remarked that while global warming raises many deep and profound ethical issues, most of the vast literature that has arisen on climate change is focused on scientific or economic questions alone. He goes on to point out that numerous formulae have been advanced in the last few years on what constitutes an equitable allocation among nations of allowable greenhouse gas emissions that would be necessary to stabilize greenhouse gases in the atmosphere at safe levels. He invites comment on the degree to which varying points of view should command equal respect and asks, if not, why not?

Discussion of genetically modified organisms would appear to fall into the same category, with references to discussion of the ethical dimensions immediately invoking images of muddle-headed greens, self-interested farmers and well-fed western yuppies moralising while suited representatives of the scientific and corporate world baffle their governments and boards with scientific jargon and promises of future profit. In few scenarios is serious notice taken of the voices of developing country representatives, where

similar polarisation of opinion exists. Such an approach caricatures all parties and grossly understates the seriousness and complexity of the issues.

At the root of all of our discussions about civil society, democracy, development, human rights, globalisation and corporate governance, are fundamental questions about 'values' and what might constitute 'ethical behaviour' among individuals and states, and between generations. Typically such conversations polarise rather than unite, with the middle ground quickly eroded by a withering array of diametrically opposed but seemingly authoritative points of view, usually couched in language designed to discredit or at least humiliate one's opponent. All too frequently, the debate ends with a shrug of the shoulders and a reference to *realpolitik* and the powerlessness of key players. Our value systems underpin all of our decisions and, as margins for error are reduced, we must grapple with the ethical dimensions of food security and sustainable development.

For present purposes we propose to fall back on a not-so-New Collins Concise English Dictionary which defines an 'ethic' as a moral principle or set of moral values held by an individual or a group, and 'ethics' as either the philosophical study of the moral values of human conduct and of the rules and principles that ought to govern it, or a code of behaviour considered correct. 'Moral' is defined as 'concerned with or relating to human behaviour especially the distinction between good and bad or right and wrong'.

Our starting point assumes that, to a greater or lesser degree, all stakeholders are committed to ethical, fair and reasonable behaviour. What is lacking is space for well-informed and objective discussion. Further, while it is agreed that ethics is a necessary element in the discussion, boundaries are not easily defined. Therefore, it seems that any evaluation of the political, socio-economic and scientific arguments regarding GM foods will inescapably reflect diverse views of the world and different ethical 'value systems'.

Some commentators believe that an examination of the ethical considerations related to the application of GMOs in agriculture is a 'First World luxury' overlooking the concerns of the hungry (Pinstrup-Andersen in Juurus 2002). The authors of this paper contend that ethics and our assessments of political, economic and

technological phenomena are intrinsically entwined. New technologies have the capacity to fundamentally alter the economic, social, legal and ecological landscapes of the area into which they are introduced. This in turn can give rise to far-reaching and multi-dimensional ethical dilemmas. Hence, from this perspective, it is advanced that ethical evaluations of new technologies are merited. Indeed, according to Ian Johnson, head of Environmentally and Socially Sustainable Development at the World Bank, 'the issues of genetically modified foods ... [are] issue[s] of ethical dimensions' (Johnson in Tikoo 2002). In addition, a number of ethical concerns have been raised upon the *intrinsic* nature of genetic engineering technologies.

## Food for the future: understanding the issues

*'The benefit of 'more food' is a difficult one to sell today in the midst of oversupply and historic low prices'. – William Kirk, former Vice-President, Du Pont (Anon. 1999).*

### Trade and development

It is possible to argue that progress on a number of other fronts holds more promise than GMOs. Nobel Prize-winning economist Amartya Sen has argued that the problem is one of food distribution, not supply, resulting from unfair trade practices including massive subsidization of producers in the industrialised world affecting producers in developing countries. To this add export-driven investment in agriculture in developing countries, with local shortages created and exacerbated by bad government, natural disasters and conflict.

*'Developed-country policies also make a difference. We know, for instance, that developed countries must replace their trade-distorting policies with policies promoting free and fair trade for developing countries. MORE RESEARCH AND BETTER POLICIES ARE ESSENTIAL FOR ACHIEVING THE WORLD FOOD SUMMIT GOAL'* (Pinstrup-Andersen 2002).

Proponents of the use of genetic engineering technologies to tackle food security issues argue that the major benefit lies in the capacity to produce *more* food economically and efficiently.

However, 'only in rare cases is hunger a matter of actual shortfalls of food' (Syngentia 2002). Indeed, a Technical Interim Report by the United Nations Food and Agricultural Organisation has revealed that although the annual rate of growth in global crop production is expected to reduce, the projected overall increment in world crop production to 2030 of 57% will exceed projected population growth (Food and Agricultural Organisation of the United Nations, Economic and Social Department 2000).

Food insecurity is not caused by insufficient supply of food. Rather, hunger is caused by the interaction of a number of inter-related economic, social, legal, and political factors that contribute to the poverty of a particular region, or nation, and thus hinders its ability to acquire food. Therefore, if the ultimate aim is to tackle food insecurity, then perhaps greater efforts should be placed upon addressing the socio-economic and political forces that contribute to poverty in the developing world instead of aiming to increase the food supply. This has major ramifications in terms of the promotion of new generation GMOs as a vehicle for improved food security, as some have argued that food security 'involves more of politics than technology, with biotechnology having virtually no role to play' (Sharma 2000).

*'Policies which sustainably improve nutrition for the poor cannot be separated from policies which reduce inequality. Economic growth, as conventionally measured, has been successful at increasing total production of goods and services, but not at generating a more even distribution of these resources'* (Butler 2001).

### Development impact

There are micro-level and macro-level, short-term and longer-term socio-economic implications associated with the use of GMOs in agriculture.

On a micro-level, supporters of increased use of GMOs argue that the use of GMOs will have significant positive impact at the household, farm and community levels in the developing world, through increased productivity, and thereby generating higher incomes for farmers and freeing up labour and resources for other activities. Recent history suggests however that, while '... the rural poor represent about 73 percent of the population living in poverty ... many poor farmers have barely benefited from agricultural

developments elsewhere ...' (Hawtin 2002). Whether and when rural farmers in developing countries would have access to newer GMO technologies in order to derive any potential benefit is unclear.

As Carliene Brenner of the Organisation for Economic Co-operation and Development (OECD) highlights, little emphasis has been placed upon ensuring that developing countries have adequate enabling conditions to facilitate the successful transfer of the new technology. This involves addressing the broader infrastructural and developmental obstacles that many developing countries currently face (Brenner 1997). Per Pinstrup-Andersen of the International Food Policy Research Institute warns (1999) that:

*'... unless developing countries have policies in place to assure that small farmers have access to extension services, productive resources, markets and infrastructure, there is considerable risk that the introduction of agricultural biotechnology could lead to increased inequality of income and wealth.'*

If access is to occur, it may occur 'at the price of increasing debt to multinationals producing GM food seed, [and] the north-south wealth disparity ... will simply increase further' (Leeder 2001; Sachs 1999). Further, increasing dependence on GMOs appears to run contrary to efforts to achieve sustainable agriculture, with farmers foregoing access to local seed banks

Proponents of increased application of GMOs have argued that while 'technology cannot redress gross inequalities in access to resources', it can nevertheless ease the situation of the poor. While this may be true, it appears to ignore the fact that inequalities in access to resources generally include inequalities in access to technological resources as well. Further, as Harvard economist Jeffrey Sachs observes 'technological gains in wealthy countries do not readily diffuse to poorer ones' which lack the necessary infrastructure. 'The developmental impact of recombinant genetics and biotechnology is only as good as the socio-political soil in which they are planted' (Syngenta Foundation for Sustainable Agriculture 2002).

*'Farming is a lifeline for three in four people in poor countries. Basic research, which assesses the effects of GM crops on their societies,*

*economies and habitats, is an essential first step. And we should not forget that poor farmers need fair agricultural trade, rather than a free for all, with access to rich countries' markets and safeguards against cheap dumped produce.'* (Potrykus and Thomson 2001).

## **No issue is without ethics**

As mentioned previously, there are many who, for theological or philosophical reasons, object to human interference with the natural order. This paper deals primarily with those ethical dilemmas which are *extrinsic*, emerging in the context of the arguments in support of GMOs as a potentially major contributor to global food security and sustainable development.

## **Prioritization and proportionality**

Sachs has pointed to the enormous disparity between resources directed to research on first-world issues and that applied to developing country needs (Sachs 1999). There appears to be a distinct imbalance between research funds and energies applied towards research that is expected to enhance private profit prospects, at the expense of research applied towards addressing global public good problems.

The increasing horizontal and vertical integration of corporations involved with the development of genetic engineering technologies raises concerns related to the concentration of actors in the industry. During the 1990s, 'innovations in transgenic crops concentrated in the hands of three major corporations' (Runge and Victor 2002). These corporations are also involved with the development of chemicals and seeds, and thus there is a tendency to integrate the development of GMOs with other herbicides and pesticides devised by the corporation. This has the potential to seriously threaten the safety and competitiveness of the food system.

## **Trade substitution**

Another concern relates to the development of GMOs as substitute products that will replace imports of raw agricultural materials from the developing world, such as vanilla, cocoa, and sugar. This is likely to have drastic consequences for economies largely dependent upon the export of such products. On the other side, this is seen as an indication of preferences by the market, and

highlights the need for diversification of economies and adaptability to market forces. However, this development could also further accelerate the loss of biodiversity as farmers may intensify production of GMOs for foreign markets with relatively larger short-term commercial gains, at the expense of growing a wider range of traditional, local and genetically diverse crops. As a result, there may be an intensification of industrial agricultural methods that seem to rely heavily on a few modern high-external-input plant varieties. This in turn increases the vulnerability of the crops and is linked to the emergence of 'monodiets'. In addition, in terms of achieving food security, Geoffrey Hawtin, Director of the Plant Genetic Resources Institute points out that 'the use of genetic diversity ... remains the best route to securing our food and that of our children' (Hawtin 2002).

### **Food safety and public health concerns**

The widespread uncertainty regarding the safety and public health aspects of GMOs has spurred efforts in the North, in particular, for better labelling of GM products and derivatives. It is arguable that, in the South especially, the application of GMOs may be proceeding ahead in the context of public ignorance and inadequate regulations.

According to Dr Mae-Wan Ho, who is a member of the Academy of Sciences, Kuala Lumpur, genetically engineered food poses unacceptable health risks:

- The hazards are inherent to the hit or miss technology
- Random gene insertions give random genetic abnormalities and unexpected effects
- New genes, gene constructs and products from viruses, bacteria and non-food species are introduced into our food for which no safety tests exist
- Interaction between introduced gene and host genes increases unexpected effects including toxins and allergens
- The technology enhances horizontal gene transfer and has the potential to generate new viruses and bacteria that cause diseases and spread drug and antibiotic resistance.

### **Ecological impact**

There are ethical concerns related to the complex and potentially far-reaching ecological impacts of GMOs. Determining the risks of GMOs is extremely difficult primarily due to its *ex ante* nature. Nevertheless, a wide range of areas of possible negative impacts has been recognised. These include risks of adverse effects upon the growth of organisms in ecosystems, contamination of conventional seeds and other organisms, the establishment of wild populations, and the potential for the acquisition of herbicide or insect resistance by non-genetically altered organisms. Many argue that the method of risk assessment of GMOs is non-universal and thus may not adequately foresee risks which may arise in different eco-systems and climates. According to a Purdue University scientist, 'it may be that things we find to be a risk in the lab aren't a risk at all in nature', thereby demonstrating the uncertainty involved in the testing and practical uses of GMOs (Tally 2002).

It is arguable that the risks associated with genetically modified crops are multiplied when applied to genetically modified animals as the latter are more mobile and thus more capable of escaping from controlled areas. In addition, it is pointed out that the application of GMOs in agriculture may accelerate the loss of biodiversity as it may lead to the 'replacement of numerous local cultivars with one or two GM strains, thereby leading to genetic erosion' (Swaminathan 1999). Loss of biodiversity is likely to have longer-term implications since it is likely to 'undermine the resistance of plants to diseases and insect pests and this may result in reduced crop yields ... global sustainable development could be put in jeopardy' (Tisdell and Xue 2000). The problem is that we have little idea how to model the effects of infusing the environment with organisms containing evolutionarily novel constellations of genes (Wills 2002).

It is asserted that GMOs will lead to a reduction in the application of herbicides and pesticides. However, this must be examined in the context of the modernised system of agriculture, which already has a heavy reliance on external inputs such as chemicals and irrigation, as well as in the context of current research and development in the field. It is apparent that most research and development in biotechnology is directed towards engineering plants resistant to the pesticides



manufactured and marketed by the same corporation. Thus, the extent to which external inputs may be reduced through the use of GMOs is questionable.

It is argued that by increasing yields and productivity, GMOs will make it 'unnecessary to put marginal or environmentally sensitive areas under plough' (Apel and Conko 2002). Yet, the relevance of increasing total food production is questionable in light of the fact that according to the United Nations' World Food Program 'more than enough food is already being produced to provide everyone in the world with a nutritious and adequate diet' (UN WFP 1998).

It is also argued that genetic engineering technologies have the potential to increase disease resistance, drought resistance, and resistance to other adverse factors in organisms to restore and increase productivity. A recent example in Thailand has resulted in a major harvest of soya beans despite the existence of drought conditions, due to the utilisation of 'soya beans that do not need water to survive' (Komolkul 2002). It is noteworthy that the soya beans in this instance were grown for the animal food and feed industries, and that soya beans are not native to this area. Thus, whether the income generated resulted in a sustainable reduction of food insecurity is unclear as 'more total food production and more income generated by the family may or may not translate into more food consumed by household members.' (Babcock and Francis 2000).

### ***Intellectual property ethics***

In a rapidly globalising and interdependent world, legal certainty is of increasing importance. The rapid expansion of scientific knowledge in the field of biotechnology and the widespread diffusion and application of genetic engineering technologies has created a number of legal challenges that can impact upon food security imperatives.

At a fundamental level there is legal uncertainty surrounding the ownership of the genetic material and knowledge used in the development of GMOs. This is of especial concern to the developing world as it contains 96% of the world's genetic resources. Unlike other natural resources covered by the Convention on Biological Diversity, genetic resources have been

declared to be the Common Heritage of Humankind. This has meant that the use of such resources has never been paid for. A related and more complex aspect is connected to the ownership of the intellectual effort and knowledge expended in the development of such resources. Most modern food varieties were created from wild plants by generations of careful breeding and selection. Hence, some countries, or communities, may expect a return for this effort. On the other hand, many countries may consider receiving payment for the private use of such resources as a cultural insult. In addition, since 'modern plant varieties combine dozens or hundreds of innovations [it] ... is practically impossible to define ownership' (Runge and Victor 2002).

While patent protection is an effective means of rewarding the intellectual effort of innovators, the monopoly power that it grants the holder can restrict access to the resource by those most in need. Indeed it has been asserted that the 'public good aspect of earlier biological techniques is being eroded with the strengthening and extension of intellectual property rights protection to agriculture in general, and biotechnology in particular' (Brenner 1997). In addition, it is argued that patent protection is stifling research that depends upon the use of patented seeds and technologies, to the detriment of the broader community, and the developing world in particular. Moreover, there have been charges of biopiracy against major developers of GMOs, with detractors arguing that 'discoveries' by Northern corporations are 'really the pirating of the accumulated indigenous knowledge of native peoples and cultures' (Shiva 1997). It has been suggested that the failure to adequately compensate the South for their indigenous genetic resources may increase the prosperity gap between the North and South.

In contrast to the Green Revolution, the dominance of private industry in the development of genetic engineering technologies has generally meant that the nature and direction of research is determined more by the commercial imperatives of food processors and rich world consumers than by the food security needs of consumers in the South. For example, the two main commercially-grown genetically engineered crops in the United States – soybeans and maize – are harvested primarily for the animal feed market (Kleiner 2002).

The extension of the patent system to the realm of GMOs has further strengthened financial imperatives, and contributed to the privatisation of scientific research. This is because the increased use of patents tends to alter the incentive structure of research such that the incentive for academics is no longer to 'publish results as quickly as possible', but rather to keep results secret so as to protect their patent privileges (Biggs 1998). In addition, there is the risk that this increasing privatisation of research 'may lead to a situation where the technologies of the future remain in the hands of a few transnational corporations' (Swaminathan 1999). Moreover, the privatisation and commercialisation of research significantly affects the 'type of technology and the kind of products that will ultimately emerge' (Hobbelink 1990). Hence, most research and genetically modified organisms created have been directed towards first-world needs and consumption patterns. Increasingly, it appears that the objective is to adapt developing world agriculture for rich countries, rather than focus on the specific ecological, agronomic and socio-economic requirements of developing-world farmers. Many Southern research programs that should serve the interests of the developing world are giving way to the concerns of private industry and first-world consumers. There is a need to strengthen public research institutions; but this is notoriously difficult in the context of declining public expenditure in agriculture and aid.

### ***Regulatory frameworks***

A number of recent developments have revealed the lacunae in existing regulatory systems to adequately address legal issues that may arise as a result of the use of GMOs. The discovery of corn containing a suspected human allergen created specifically for animal feed purposes demonstrates the practical difficulties of separating GM and non-GM varieties, as well as the inadequacies of current regulatory mechanisms to prevent such scenarios (Franz 2002). The US-based Farmers' Legal Action Group has identified a number of tort-based and contract-based liabilities that might arise for farmers as a result of using GMOs (Moeller 2001).

### ***Information ethics – availability, accuracy, access***

Perhaps the most significant ethical dilemma is related to the widespread uncertainty regarding the impact of GMOs in agriculture, and towards global food security. Indeed, it has been asserted that the debate is being conducted in a 'data-free environment'. The seriousness of this lack of clarity and consensus regarding the impact of GMOs is underlined by the reluctance of insurance companies to 'issue protection against claims of damage to the environment and health.' (Swaminathan 1999). Arguably, related to this is the unwillingness of companies to label their products as 'genetically altered'. Thus, an ethical dilemma arises. The dilemma relates to determining the level of uncertainty that is acceptable to all major stakeholders. Further, the dilemma relates to the uncertainty regarding the extent to which GMOs will actually promote the advancement of food security and sustainable development objectives. And, finally, this factor seems to permeate the other ethical dilemmas related to GMOs, as 'fear arises because we remain deeply ignorant about the intricacies of gene function' (Leeder 2001).

The concentration of 'ownership' is a further cause of concern in terms of information flow, with a small number of very large multinational companies based in developed economies being responsible for almost all of the research on transgenic crops. This increasing privatisation of knowledge related to GMO research, and the associated commercialisation of scientific research in this field, raises serious concerns with regard to availability, accuracy and access to vital information.

### ***The ethics of decision-making***

As with all issues of major importance, issues arise with respect to decision making. Who speaks for shareholders? For scientists? For producers? For consumers? How are inter-generational considerations taken into account? Who speaks for today's hungry? For future generations?

In decision-making processes, what is the balance of power among and between developed and developing countries? Among and between public, private and civil sector groups?

At the end of the day, who decides? And on the basis of whose definition of objectives and essential criteria? Who in this debate speaks for future generations? And where points of view differ, who decides and whose criteria count and at what cost?

### ***The ethics of time***

There is no ‘quick fix’ for global food security but

*‘every minute lost, every decision delayed, means more deaths from starvation and malnutrition, and means the evolution to irreversibility of phenomena in the environment. No one will ever know for sure the human and financial cost of lost time’.* (Meadows *et al.* 1972).

Given this urgency, while accelerated economic development based on fair trade and good governance would offer the best prospects for enhanced food security, it is impossible to ignore the possible benefits of genetic modification among the remedies available.

### **Food for the future and GMOs: recommended solutions**

For many, the ‘food for a crowded planet’ debate only confirms that progress on a number of other fronts may be more beneficial in terms of advancing the prospects of the developing world. In particular:

- Understanding the real costs associated with the first-world ‘trade charade’, particularly since they may outweigh many of the anticipated benefits associated with GMOs;
- Addressing the declining levels and selective applications of development assistance;
- Broadening the scope of development research beyond ‘donor’ interests, and providing greater resourcing of independent development research.

GMOs raise a plethora of highly complex and debatable ethical, socio-economic, ecological, legal, public health, food safety and inter-generational equity questions. The political, economic, legal, and socio-economic impacts of GMOs upon developing countries are many and varied and the potential benefits and risks of GMOs depend largely upon the specific circumstances of the country concerned.

The issue therefore arises: among the ‘more accessible remedies’, do new generation GM foods offer significant prospects for improving food security in the short to medium term, or are they ‘unsafe, unwarranted and unnecessary’?

### ***Publicly funded research***

It is unlikely that this question can be answered without a comprehensive analysis of the likely benefits and risks and the socio-economic, legal, environmental and ethical implications. An impartial evaluation of the merits of alternative approaches will also be required to ensure that resources are directed to those remedies likely to deliver greatest benefit, taking into account the views and interests of the poor.

### ***Policy and regulatory options***

Public policy options available to ensure that GMOs are harnessed for the benefit of humanity include:

- Establishing an open, transparent and inclusive multi-stakeholder consultative process to identify possible regulatory frameworks to address the numerous issues raised by GMOs;
- Ensuring first world support for developing country participation in international negotiations;
- Strengthening regulatory mechanisms to address the legal, economic, ecological and social issues that may arise as a result of the use of GMOs in agriculture;
- Promoting greater accountability and transparency, especially in terms of the conveying of theoretical results and motives for research, by all major stakeholders and sectors – public, private and civil society;
- Developing independent, well-informed, and reliable bodies to monitor long-term socio-economic, health, safety and ecological impacts;
- Supporting efforts within international information technology regimes to secure long-term access by developing countries to knowledge and technology on GMOs;
- Reviewing intellectual property laws to ‘balance the need to provide incentives for

innovation against the need of poor countries to get the results of innovation' (Sachs 1999);

- Promoting greater tri-sector partnerships and collaboration, as well as increased North-South co-operation in research and development, policy and priority setting, in order to ensure that GMOs are used to effectively tackle the multiple and inter-related causes of hunger and poverty in the developing world;
- Facilitating greater international co-operation and coordination in identifying, understanding, and addressing the principal, and primarily political, factors that contribute to global food insecurity and poverty, rather than aiming to increase the food supply; and,
- Invoking the precautionary approach as an internationally agreed way of dealing with the uncertainties related to the use of GMOs in agriculture.

*We must ensure that we consciously choose our future, rather than let advancing science drive us into one by default.* (Kristof 2002).

## Guidelines

A number of commentators have presented ethical frameworks within which it is possible to examine and evaluate the implications of GMOs. In *Modern Biotechnology: Legal, Economic and Social Dimensions*, Macer (1995) has presented a number of guidelines that may facilitate the evaluation of GMOs as they relate to the imperatives of food security and sustainable development. The principles are:

1. **Autonomy** – what is the benefit? to whom?
2. **Principle of no harm to humans** – what is an acceptable level of risk?
3. **Principle not to cause pain** – protect animal rights as much as possible
4. **Protect the environment** – is the technology environmentally sustainable?
5. **Justice** – to all people, and future generations
6. **Ensure independent, open and transparent decision making** – on safety, scientific, economic, social, legal and political implications

7. **Inform and educate the public** – about all dimensions of projects.

## Conclusion

The principal question is whether the application of GMOs in agriculture will advance the objectives of food security and sustainable development. It is clear that GMOs offer a variety of exciting new techniques for improving crop yields, productivity and efficiency, and for increasing crop resistance to environmental and climatic constraints. However, in terms of meeting the direct human need of eliminating hunger and malnutrition in the developing world, the contribution of GMOs is questionable.

Due to a myriad of inter-connected factors, GMOs have been largely developed by private industry to meet the needs and preferences of the rich. In addition, where GM products have been developed with developing world interests in mind, they do not adequately address the core forces that contribute to hunger and poverty in the developing world.

*John Madeley (2002) believes that our current hi-tech, agrochemical-dependent, corporate-dominated farming system has failed to feed the hungry. He argues that we already have the experience on which to base a new approach – ideas such as sustainable agriculture, low-external-input agriculture, organic food production, permaculture and the reintegration of traditional farming techniques.*

At best, GMOs may increase the purchasing power of a number of the elite farmers in the developing world. At worst, the use of GMOs in world agriculture may exacerbate the underlying structural causes of world hunger, thereby intensifying the problem.

If, in the context of informed, dispassionate debate, already accessible remedies are shown to deliver more immediate, more sustainable benefit, increased investment in existing remedies is our first priority. These remedies include wider application of existing knowledge and techniques; increased support for research on developing country issues; management of the results of that research in the public interest; and improved management of natural resources, especially water; and promotion of sustainable agriculture.

The challenge is to ensure that the combined goals of food for present and future generations and sustainable development are the primary focus of our efforts, with or without GMOs.

## References and bibliography

- Anon. (1999) *Feast or Famine: The Impact of Biotechnology on Global Food Markets*. World Bank Seminar, Washington DC, September 1999.
- Anon. (2002) Good governance in poor countries will end hunger faster than rich-world aid. *The Economist*, 13 June 2002.
- Anon. (2002) The world grows enough food. The hungry need economic growth. *The Economist*, 13 June 2002.
- Ackerman, J. (2002) Challenges for humanity: food – how safe? How altered? *National Geographic*, 11 May 2002, pp. 2-50.
- Agrifood Awareness Australia (2002) *Gene Technology in Australia: Fact not Fiction*. AFAA, Kingston: Available at: <http://www.afa.com.au>
- Altieri, M. and Rosset, P. (1999) Ten reasons why biotechnology will not ensure food security, protect the environment and reduce poverty in the developing world. *AgBioForum* 2(3 & 4), 155-162, available at: <http://www.agbioforum.org>
- Apel, A. and Conko, C. (2002) *31 Critical Questions in Agricultural Biotechnology*. Available at: [http://www.agbioworld.org/biotech\\_info/articles/critical.html](http://www.agbioworld.org/biotech_info/articles/critical.html)
- Asian Development Bank (2001) *What Prospects and Pitfalls does Biotechnology hold in the Pursuit of Food Security for Asia?* Available at: <http://www.adb.org/documents/books/agri-biotech/default.asp>
- Babcock, C. and Francis, C. (2000) Solving global nutrition challenges requires more than new biotechnologies. *Journal of the American Dietetic Association* 100, 1308-1311.
- Biggs, S. (1998) The biodiversity convention. In: Kiely, R. and Marfleet, P. (eds). *Globalisation and the Third World* Routledge, London, pp. 128-137.
- Brenner, C. (1997) Biotechnology policy for developing country agriculture. *OECD Development Centre Policy Brief No. 14*, 10 pp., available at: <http://www.oecd.org>
- Butler, C. (2001) No free lunch – the global distribution of food and micronutrient entitlement. *National and Society Forum's Food Conference Proceedings*, 5 pp. available at: <http://www.natsoc.org.au/html.conferences.html>
- Comstock, G. (2000) *Vexing Nature: On the Ethical Case against Agricultural Biotechnology*. Kluwer Academic Publishers, Boston.
- Cross, N. (2002) Sustainable development explained. *Developments* 18, Second Quarter 2002, 6, available at: <http://www.developments.org.uk>
- Dasgupta, K. (2001) Poverty amidst plenty: the Punjabi tale. *UNESCO Courier*, September 2002, available at: [http://www.unesco.org/courier/2001\\_09](http://www.unesco.org/courier/2001_09)
- Da Silva, E., Ratledge, C. and Sasson, A. (eds) (1992) *Biotechnology: Economic and Social Aspects*. Cambridge University Press, Cambridge.
- Demenet, P. (2001) Can genetically modified organisms feed the world? *UNESCO Courier*, September 2001, available at: [http://www.unesco.org/courier/2001\\_09](http://www.unesco.org/courier/2001_09)
- Dibb, S. and Mayer, S. (2000) Biotech – The next generation: Good for whose health? Available at: [www.genewatch.org](http://www.genewatch.org)
- Epstein, R. (1998) Redesigning the world: ethical questions about genetic engineering. Available at: <http://online.sfsu.edu/%7Eerone/GEessays>
- Food and Agricultural Organisation of the United Nations, Economic and Social Department (2000) *Agriculture: Towards 2015/30*. Technical Interim Report. FAO Rome 25, 90-96.
- Food and Agriculture Organisation of the United Nations (2001a) *Ethical Issues in Food and Agriculture*. FAO, Rome. Available at: <http://www.fao.org/ethics>
- Food and Agriculture Organisation of the United Nations (2001b) *Genetically Modified Organisms, Consumers, Food Safety and the Environment*. FAO, Rome, available at: <http://www.fao.org/ethics>
- Food and Agriculture Organisation of the United Nations (2001c) *Report of the Panel of Eminent Experts on Ethics in Food and Agriculture*. FAO, Rome. Available at: <http://www.fao.org/ethics>

- Food and Agricultural Organisation of the United Nations, Economic and Social Department (2000) *Agriculture: Towards 2015/30*. Technical Interim Report, FAO, Rome **25**, 90-96.
- Franz, F. (2002) \$9m settlement paid to consumers over StarLink contamination. *Chemical Week* 20 March 2002.
- Hawtin, G. (2002) Genetic diversity and food security. *UNESCO Courier* May 2002, available at: [http://www.unesco.org/courier/2000\\_05](http://www.unesco.org/courier/2000_05)
- Hildyard, N., Lohmann, L. and Sexton, S. (1998) Genetic engineering and world hunger. The Cornerhouse, available at: <http://cornerhouse.icaap.org/briefings/10.html>
- Ho, M. (2001) Towards a new ethic of science, available at: <http://www.iss.org.uk/newethic.php>
- Hobbelink H. (1990) *Inside the Biorevolution*. International Organisation of Consumers Unions, Penang.
- International Food Policy Research Institute [2002] <http://www.ifpri.org>
- Johnson, I. in Tikoo, R. (2002) Economic growth must neither compromise natural assets nor ignore the social dimension. *The Financial Express India* 24 March; available at: [http://www.financialexpress.com/fe\\_full\\_story.php?content\\_id=5200](http://www.financialexpress.com/fe_full_story.php?content_id=5200)
- Juurus, K. (2002) Gene-altered food – the bad saviour. *Helsingin Sanomat* 21 April 2002.
- Kleiner, K. (2002) Fields of gold? – Biotech's cash benefits may not be what they seem. *New Scientist* 22 June 2002.
- Komolkul, J. (2002) More Thai farmers growing drought resistant soy. *Asia Intelligence Wire*, 2 May 2002, available at: [www.soyatech.com](http://www.soyatech.com)
- Kristof, N. (2002) Interview with a humanoid. *New York Times*, 23 July.
- Kwa, A. (2001) Agriculture in developing countries: which way forward? The South Centre, available at: <http://www.southcentre.org/publications/pubindex.htm#working>
- Lappé, M. (2000) On the application of the precautionary principle. Centre for Ethics and Toxics, available at: <http://www.cetos.org/agbio.html>
- Leeder, S. (2001) GM food: ethical and public health aspects. *The National and Society Forum's Food Conference Proceedings*, 3 pp., available at: <http://www.natsoc.org.au/html.conferences.html>
- Leisinger, K. (1999) The ethical challenges for green biotechnology for developing countries. *CGIAR / NAS Biotechnology Conference*, Washington DC, USA, 21-22 October 1999. CGIAR (Consultative Group in International Agricultural Research), Washington DC, USA, 115; available at: <http://www.cgiar.org/biotech/papers.htm>
- Macer, D. (1995) Bioethics and biotechnology: what is ethical biotechnology? In: Brauer, D. (ed.) *Modern Biotechnology: Legal, Economic and Social Dimensions*. *Biotechnology* **12**, 115-154. VCH, Weinheim, Germany.
- Macer, D. (1997) Bioethics. *Biotechnology and Development Monitor* No. 32, 2-5.
- Macer, D (1995) Bioethics and biotechnology: what is ethical biotechnology? In: Brauer, D. (ed.), *Modern Biotechnology: Legal, Economic and Social Dimensions*. *Biotechnology Volume 12*. VCH, Weinheim, Germany, pp.115-154.
- Madeley, J. (2002). *Food for All*. Zed Books, London.
- Madeley, J. (1992) *Trade and the Poor*. Intermediate Technology Publications, London, pp. 96-103.
- McGloughlin, M. (1999) Ten reasons why biotechnology will be important to the developing world. *AgBioForum* **2**(3 & 4), 163-174, available at: <http://www.agbioforum.org>
- Meadows, D.H. *et al.* (1972) *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. Universe Books, London. 205 pp.
- Moeller, D. (2001) GMO liability threats to farmers. Farmers' Legal Action Group. Available at: <http://www.gefoodalert.org>
- Nottingham, S. (1998) *Eat Your Genes*. Zed Books, London.
- Nottingham, S. (2002) *Genescapes*. Zed Books, London. 170 pp.
- Nuffield Council on Bioethics (1999) *Genetically Modified Crops: The Ethical and Social Issues*. Nuffield Council on Bioethics, London, available at: [http://www.nuffieldbioethics.org/publications/pp\\_0000000009.asp](http://www.nuffieldbioethics.org/publications/pp_0000000009.asp)

- Overseas Development Institute (1999) The debate on genetically modified organisms: relevance for the South. Briefing Paper, 1 January 1999, available at: <http://www.odi.org.uk>
- Paarlberg, R. (2000) Governing the GM crop revolution: policy choices for developing countries. *Food, Agriculture and the Environment Discussion Paper 33*, International Food Policy Research Institute, available at: <http://www.ifpri.org>
- Phelps, B. (2001) Unnatural devices – genetically engineered organisms. *National and Society Forum's Food Conference Proceedings*, available at: <http://www.natsoc.org.au/html.conferences.html>
- Pinstrup-Andersen, P. (1999) Modern biotechnology for food and agriculture-social and economic risks and benefits for low-income people in developing countries. *CGIAR / NAS Biotechnology Conference*, Washington DC, USA, 21-22 October 1999. CGIAR (Consultative Group in International Agricultural Research), Washington DC, USA, 115; available at: <http://www.cgiar.org/biotech/papers.htm>
- Pinstrup-Andersen, P. (2002) Speech at *The World Food Summit: Five Years Later* Rome, Italy, June 2002.
- Pinstrup-Andersen, P. in Juurus, K. (2002) Gene-altered food – the bad saviour. *Helsingin Sanomat* April 21.
- Pollack, L. (2001) The green revolution yields to the bottom line. *The New York Times* 15 May 2001.
- Potrykus, I. and Thomson, K. (2001) Harvest of hope or fear? *The Guardian*, April 18, available at: <http://society.guardian.co.uk/societyguardian/story/0,7843,474108,00.html>
- Prakash, C. (2000) Can genetically engineered crops feed the world? – Yes – we must tap biotech's potential. *The San Francisco Chronicle* 30 March 2000, available at: <http://www.agbioworld.org>
- Reiss, M. and Straughan, R. (2001) *Improving Nature? The Science and Ethics of Genetic Engineering*. Cambridge University Press, Cambridge.
- Rifkin, J. (1998) *The Biotech Century*. Penguin Putnam, New York.
- Runge, C. and Victor, D. (2002) Farming the genetic frontier. *Foreign Affairs* **81**(3), 107.
- Sachs, J. (1999) Helping the world's poorest. *The Economist*, 14 August 1999, pp. 17-19.
- Sechler, S. (2002) Starved for attention: globalisation has increased the need to end world hunger in the developing nations – and has provided the means to do it. *The American Prospect* 1 January 2002 **13**(1).
- Sharma, D. (2000) Starvation and politics. *Organic New Zealand* September 2000 **59**(5), 34 pp. Available at: <http://www.soil-health.org.nz/pastissues.htm>
- Shiva, V. (2000a) *Stolen Harvest*. Zed Books, London.
- Shiva, V. (2000b) The world in a grain of rice. *The Ecologist* **30**(9), 22 November 2000. Available at [http://www.theecologist.org/archive\\_article.html?article=167&category=58](http://www.theecologist.org/archive_article.html?article=167&category=58)
- Shiva, V. (1997) Bioethics – a Third World issue. *Environmental News Service* I p., 30 July 1997.
- Stanton, R. (2001) Who's driving the food supply? *National and Society Forum's Food Conference Proceedings*, available at: <http://www.natsoc.org.au/html.conferences.html>
- Swaminathan, M. 1999. Genetic engineering and food, ecological and livelihood security in predominantly agricultural developing countries. *CGIAR / NAS Biotechnology Conference*, Washington DC, USA, 21-22 October 1999. CGIAR (Consultative Group in International Agricultural Research), Washington DC, USA, 115; available at: <http://www.cgiar.org/biotech/papers.htm>
- Syngenta Foundation for Sustainable Agriculture. [2002] The socio-political impact of biotechnology in developing countries. Available at: [http://www.syngentafoundation.com/biotechnology\\_developing\\_countries.htm](http://www.syngentafoundation.com/biotechnology_developing_countries.htm)
- Tally, S. (2002) Ecological risks of GMOs come in unexpected ways, model shows. 19 June 2002, available at: [www.checkbiotech.org](http://www.checkbiotech.org)
- Tikoo, R. (2002) Economic growth must neither compromise natural assets nor ignore the social dimension. *The Financial Express India* 24 March 2002, available at: [http://www.financialexpress.com/fe\\_full\\_story.php?content\\_id=5200](http://www.financialexpress.com/fe_full_story.php?content_id=5200)
- Tisdell, C. and Xue, D. (2000) Safety and socio-economic issues raised by modern biotechnology. *International Journal of Social Economics* **27**, 699-708.
- Tripp, R. (2000) GMOs and NGOs: biotechnology, the policy process, and the presentation of evidence. *Natural Resource Perspectives* No. 60, 1-6.

- Tripp, R. (1997) Unproductive debates: the green revolution, biotechnology and agricultural diversity. *Biotechnology and Development Monitor*, No. 32, 24. Available at: <http://www.biotech-monitor.nl>
- UN WFP cited in Hildyard, N., Lohmann, L. and Sexton, S. (1998) Genetic engineering and world hunger. *The Cornerhouse*, 2 pp., available at: <http://cornerhouse.icaap.org/briefings/10.html>
- United States Department of State (2000) Fact Sheet – Healthy harvests: growth through biotechnology. Available at: <http://www.usinfo.state.gov/topical/global/biotech>
- Visser, B. (1998) Effects of biotechnology on agrobiodiversity. *Biotechnology and Development Monitor* No. 35, 2-7. Available at: <http://www.biotech-monitor.nl>
- Wills, P. (2002) Genetic engineers know not what they can do. *Canberra Times*, 16 May.
- Xue, D. and Tisdell, C. (2000) Safety and socioeconomic issues raised by modern biotechnology. *International Journal of Social Economics* **27**, 699-708.
- Zimmerli, W. (1994) Patenting of human genes and living organisms: an ethical point of view. In: Grunwald, R. and Vogel, F. (eds) *Patenting of Human Genes and Living Organisms* Springer, Heidelberg.