The use of genetically modified crops in developing countries

a guide to the Discussion Paper

Introduction

The Nuffield Council on Bioethics provoked vigorous debate with the publication of its Report, **Genetically modified crops: ethical and social issues** in 1999. One of the conclusions, based on the evidence available at the time, was that there was a moral imperative for making GM crops readily and economically available to people in developing countries who wanted them. In 2003, the Council felt it was important to examine whether the arguments for this conclusion were still valid. We have done this by publishing a follow-up Discussion Paper which focuses specifically on the use of GM crops in developing countries.

This summary sets out some of the arguments and recommendations which are discussed in more detail in the Discussion Paper. The Paper reviews recent scientific evidence, socio-economic trends, and developments in policy, regulation and trade.

[Notes in square brackets throughout refer to Sections and paragraphs in the Discussion Paper].

The context

There are many factors that contribute to poverty and hunger in developing countries, including war, political instability, lack of infrastructure and poor economic conditions. We do not claim that the use of GM crops alone will eliminate the need for political, social or economic change, or that they will simply 'feed the world'. We recognise that we are discussing only part of a much larger picture. But since agriculture has a crucial role to play in developing countries, especially as a source of employment, income and food for the poorest people, it is important to assess the potential contribution of GM crops.

Today, the majority of GM crops are grown in developed countries and address the needs of commercial farmers. However, farmers in developing countries are increasingly beginning to adopt GM crops. 16 million hectares are being grown in developing countries, by 4.5 million farmers. Most of these are small-scale farmers in China and South Africa, growing GM cotton.

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RECENT TRENDS IN POVERTY AND HUNGER IN DEVELOPING COUNTRIES

- 777 million people in developing countries, including one third of the population of sub-Saharan Africa, are undernourished.
- Over one billion people, almost all in Asia and Africa, survive on less than US $1 a day. Over half of these people depend primarily on agriculture for their living. There are approximately 817 million small-scale subsistence farmers in developing countries.
- Estimates of population growth suggest that food requirements are likely to rise substantially in the next 20 years.
- It is predicted that the proportion of the population which is of working age in developing countries will rise. Employment opportunities will also need to increase to provide income and economic growth.
- New varieties of crops introduced in Asia between the 1960s and the 1980s increased crop yields significantly, allowing agriculture to provide food and work for a growing population, and reduce poverty. However, the improvements in crop yields achieved then have now slowed. Additionally, benefits of the Green Revolution failed to reach Africa.

Could GM crops make a difference?

We consider options for increasing agricultural production [Chapter 2]. One possibility would be to expand areas of farmland. However this is rarely feasible and usually not environmentally friendly. It may involve, for example, destroying forests. The only alternative would be for farmers to find ways to increase yields from the same amount of land. Raising yields of staple crops could provide more food and more employment (and therefore more income to buy food).

However, physical conditions for agriculture are worsening. Farmers are faced with problems of increasing water shortages and ever poorer soils. Conventional cross breeding techniques have been slow to address these problems. There are indications that GM technology will provide new approaches and we review the evidence to assess whether GM crops, directed towards specific agricultural problems, could help to increase crop yields.

Risk assessment: the precautionary approach

It is sometimes argued that GM crops should not be used because of the possibility of an unpredictable adverse effect. The *precautionary principle* is frequently interpreted to mean that, whatever the possible benefits, a new technology should never be introduced unless there is an absolute guarantee that no risk will arise. However, this restrictive interpretation is essentially impractical. It would mean technologies such as vaccination, aeroplanes and mobile phones, now widely accepted, would never have been allowed.

We conclude that an appropriate interpretation is a more flexible *precautionary approach*. By this we mean that the risks arising from the use of GM crops need to be compared with the risks of other possible courses of action, and of 'doing nothing'. Introduction of a GM crop may pose fewer risks than exist with the current agricultural system. For example, a GM crop could reduce the amount of pesticides used. The risks of 'doing nothing' may often be as great, or greater than the risks of action.

POSSIBLE BENEFITS OF USING GM CROPS IN DEVELOPING COUNTRIES

Pest infestations, diseases and poor weather conditions may all significantly lower crop yields in developing countries. GM crops could address these problems, where other breeding techniques have failed. We consider a series of case studies [Chapter 3]:

- **Insect / pest resistance**
  Half the cotton grown in China in 2002 was genetically modified to produce a substance that is poisonous to the cotton bollworm, a pest that devastates many cotton crops. Farmers had previously applied the toxin directly by spraying the crops. The benefits of the '*Bt* cotton' are a reduction in pesticide use, an increase in yields and profits, and health benefits for farm workers who often apply pesticides without protective clothing.

- **Disease resistance**
  Plants can be genetically modified to be resistant to bacterial, fungal or viral infestation. Examples include research on sweet potatoes to improve viral resistance and bananas modified to resist the Black Sigatoka fungus. Untreated, this fungus can reduce banana yields by as much as 70% but fungicides are expensive.

- **Crops that can withstand environmental stresses** (e.g. drought, heat, frost, acid or salty soil)
  A gene from a plant which can survive prolonged water stress in desert conditions has been introduced into rice. This allows rice to produce a sugar that protects the plant during dehydration, allowing it to survive periods of drought.

- **Herbicide tolerance**
  Plants can be genetically modified to be tolerant to a specific weedkiller. This allows farmers to control a wide range of weeds with less weedkiller while not affecting the modified crop. Herbicide tolerant crops are grown mainly in developed countries. However, recently they have been used in some developing countries. For example, more than 90% of soybeans grown in Argentina during 2002 were GM.

- **Improved nutritional value**
  Crops can be genetically modified to contain additional nutrients that are lacking from the diets of many people in developing countries. One example is Golden Rice, which has been modified to have enhanced levels of ß-carotene, in order to help to prevent vitamin A deficiency. 14 million children under five suffer clinically from this deficiency, which can cause childhood blindness.

- **Biopharmaceuticals**
  Plants could be genetically modified to produce vaccines or other medicines. Potatoes have been modified to produce edible vaccines against E. coli bacteria which cause diarrhoea. This would allow cheap and easy distribution of the vaccine, but research is still at a very early stage.

CONCERNS ABOUT GM CROPS

Are GM crops safe to eat?

Some people feel that the effects of GM crops on human health are not yet adequately understood. There are concerns about the use of viral DNA during the modification process, and some question whether there would be new health risks if genes introduced in a GM crop were to be taken up by the human body. The safety of GM crops is often assessed by comparison with the closest conventional counterpart.

> *We concluded that the current evidence from safety assessments of GM crops does not suggest any significant risks to people who eat them. We welcome the fact that concerns about GM have focused attention on issues of safety attaching to new crops and varieties [paras 4.43-4.47].*

What are the environmental risks of introducing GM crops in developing countries?

There are concerns that the introduction of GM crops might lead to a reduction in biodiversity (the variety of plants and animals in the wild), particularly in areas where a crop originated and a wide range of natural genetic variation is found. There might also be unexpected consequences of gene transfer (or 'gene flow') between plants, for example an irreversible or uncontrollable 'escape' of genes into neighbouring wild plants by pollen. There are also concerns that pests or weeds could acquire resistance to crops.

> *We concluded that the risks of gene flow need to be assessed on a case by case basis. Gene flow occurs widely throughout nature. Whether or not it is acceptable depends primarily on its consequences. The possible risk would depend largely on the particular crop and trait. We are not persuaded that possible negative results of gene flow in some areas are sufficient to rule out the planting of GM crops elsewhere in developing countries. There are also a number of ways of preventing and controlling gene flow. It is important to have sufficient seed banks to conserve genetic resources of crops effectively [paras 4.28-4.34].*

Are GM crops unnatural?

Many people are concerned that genetic modification is 'unnatural'. Arguments about naturalness are complex, and raise many difficult issues. We discuss these in detail, particularly in relation to similarities and differences between conventional and GM plant breeding techniques. The transfer of genes between species is often thought to be particularly unacceptable because it violates boundaries between natural species.

> *We take the view that all forms of plant breeding have directly and indirectly changed individual crops or biodiversity in general. Risks and benefits of specific interventions need to be considered in individual cases. We do not think that arguments about 'naturalness' are convincing enough to rule out the responsible exploration of the potential of GM [paras 3.7-3.17].*

Should we be concerned about corporate control?

Five agricultural biotechnology corporations now control most of the technology needed to develop GM crops, as well as the agrochemicals and crop germplasm (tissue from which new plants can be grown, for example seeds, plants or leaves). There are concerns that companies and those who own intellectual property rights have undue influence over the availability of GM crops. Access to this technology and germplasm is crucial for further research. Additionally, much of GM research currently only serves the interests of large-scale farmers in developed countries, for example by focusing on traits such as herbicide tolerance.

> *We recommend that additional resources should be committed by the UK government and the EC to fund a major expansion of GM-related research relevant to the needs of small-scale farmers in developing countries [Chapter 6].*

THE USE OF GM CROPS IN DEVELOPING COUNTRIES

We consider a number of questions that are frequently asked about the introduction of GM crops in developing countries [Chapter 4]:

In view of the amount of food available worldwide, are GM crops really necessary?

Some people argue that enough food is produced to feed the world's population already, and that more effort should be put into better food distribution. However, there are several problems with this argument. First, there are serious logistical and political obstacles that hinder redistribution. Secondly, the growing demand for meat, milk and eggs also requires far more staple crops. Agriculture is a vital part of people's livelihood in developing countries. Even in areas where there is a food surplus, such as India, there is currently undernourishment due to serious poverty.

> *While it is crucial to strive for a fairer distribution of land, food and purchasing power we take the view that it would be unethical to rely entirely on these means to address food insecurity. Redistribution is extremely difficult, and there is therefore a duty to explore the possible contributions that GM crops can make. It is unlikely that the amount of food available today will feed the population expansion expected over the next 50 years.*

Can GM crops help to solve health problems in developing countries?

Scientists claim that Golden Rice, modified to produce ß-carotene, could help prevent vitamin A deficiency in Asia, but opponents question whether it would actually achieve this aim. At present, there is no robust scientific evidence for either claim. There is uncertainty both about the bioavailability of ß-carotene from Golden Rice, and about conversion rates for the production of vitamin A in man.

> *We recommend that it is essential to continue research to establish how effective the approach might be. Golden Rice could make a valuable contribution where other sources of vitamin A are not easily available. It should be compared with alternative methods of improving micronutrients in the diet such as the provision of vitamin supplements through public health programmes.*

Will GM crops only be of benefit to large-scale farmers? How would they contribute to international trade?

Although GM crops primarily benefit large-scale farmers, many small-scale farmers in China and South Africa have already successfully grown GM cotton. In China, yields were estimated to have increased by 10% compared to non-GM crops, and the amount of pesticide used fell by as much as 80%, leading to an increase in profits. The efficiency of agriculture has a major impact on the standard of living in most developing countries. It is also important to consider the implications that the introduction of GM crops may have for international trade. Exports from developing countries include tea, coffee, cocoa, sugar and cotton.

> *We believe that in many instances, GM crops may offer significant improvements to subsistence agriculture. It is also important that exports from developing countries can compete on the world market. If GM crops become more widespread in developed countries, farmers who use non-GM varieties may face financial disadvantages, and the gap between rich and poor could be increased even further.*

THE USE OF GM CROPS IN DEVELOPING COUNTRIES

Can GM crops be introduced in such a way that local customs and practices are respected?

There are concerns that the introduction of GM crops will destroy traditional agricultural practices. One example is the practice of many farmers in developing countries of saving seed between harvests, rather than buying new seed each year. It is suggested that the introduction of GM crops will force farmers to buy seed. There are also concerns that in some situations, GM herbicide tolerant crops could lead to a reduction in the demand for labour for weeding on farms.

> *We recommend that it is important to ensure that local traditions are respected and that farmers are involved in decision making. The use of GM crops will not necessarily spread Western farming practices and genetic modification can be used to improve traditional crops. However, there may be cases where one type of GM crop, such as a GM herbicide tolerant crop, is less useful for a specific kind of farmer in a particular country. There are also likely to be problems if a single company dominated the seed market. It is desirable that, as far as possible, farmers have a genuine choice. To provide this, it is important to encourage research, through public sector support, into crops (whether GM or not) that can be retained by farmers with minimal loss of yield.*

What is the best method of achieving sustainable agriculture?

Yields of almost all crops are significantly lower in developing countries than developed countries, because of problems of poor soil and pest infestation. Some people argue that the use of organic farming methods, integrated pest management and mixed cropping would be a more appropriate solution than the use of GM technology.

> *We concluded that sustainable agriculture can be achieved most effectively when different approaches are combined appropriately. This includes organic and contemporary plant breeding as well as GM techniques. It is unlikely that organic farming alone can cope with agricultural challenges in developing countries, and other important strategies in agricultural practice should not be neglected.*

Food Aid

In 2002, Zambia, Zimbabwe and Mozambique faced dramatic food shortages which threatened more than ten million people with starvation. However, their governments rejected donations of food aid from the US because it consisted of GM maize. Zimbabwe and Mozambique eventually accepted food aid in the form of milled GM maize, but the Zambian government did not. We explore this controversy, and the reasons behind it.

> *We recommend that developing countries must be given a genuine choice between GM and non-GM food aid where possible. When developing countries prefer to receive non-GM grain, it should be purchased by the World Food Programme and other food aid organisations wherever possible. If only GM donations are available, and the concern is about risks to the environment rather than to health, food aid donations should be provided in milled form [paras 5.37-5.42].*

DEVELOPMENTS IN POLICY, REGULATION AND TRADE

Decisions about the development, planting and regulation of GM crops take place at many levels, from international regulations down to individual farmers. We outline the system of international governance applying to GM crops and highlight ethical and regulatory issues. We then discuss a number of specific challenges applying to developing countries [Chapter 5]:

- **Level of regulation**
  Developing countries have to ensure that their policies make sense in the context of their own development needs and also take account of the complex range of international regulations. Should decisions about the planning of GM crops be made at a local, regional or national level? We discuss the advantages and disadvantages of allowing decisions to be taken at a local level.

> *We believe that the transfer of experience from advisory and regulatory bodies in developed countries to the developing world is urgently needed. It is important to develop the technical capacity and expertise to regulate the use of GM crops in developing countries. Local communities must be included as far as possible in processes of decision making, and balanced information must be provided.*

- **Risk assessments**
  Undertaking risk assessments, both for health and environmental safety, entails considerable financial and logistical challenges. At present, few developing countries have the capacity for this.

> *We feel the most appropriate approach would normally be a centralised and evidence-based safety assessment at the national or regional level. Environmental and health risks should be assessed on a case by case basis.*

- **The impact of European and international trade policy**
  International controversies and European scepticism may deter those in developing countries from adopting GM crops. Additionally, EU policy is of considerable significance for developing countries that grow crops for export.

  It would be extremely difficult for most developing countries to comply with strict EU requirements for traceability and labelling. Regulations propose that a GM crop must be traced throughout the entire production and distribution process. The threshold for labelling proposed is also very low: any food with more than 0.9% of an approved GM material, or 0.5% of an unapproved GM material, must be labelled. Many developing countries do not have the necessary infrastructure to meet these regulations. There is also concern that even planting GM crops purely for domestic use might jeopardise an export market for non-GM crops.

> *We concluded that the freedom of choice of farmers in developing countries is likely to be restricted severely by the agricultural policy of the EU. EU regulators have not paid sufficient attention to the impact of EU regulations on agriculture in developing countries.*

Liability

It has been suggested that the multinational seed industry might exploit farmers in developing countries using GM crops, by providing lower quality seed. We are not aware of any such instances. It is clear that the same standards of liability need to apply to both developing and developed countries.

> *Where there is clear evidence of damage attributable to the seed producer, compensation will need to be provided, regardless of whether the seed is GM or non-GM. Wherever possible, agreements between policy makers and the seed industry should be established, to facilitate compensation of small-scale farmers (para 5.36).*

Summary

- ***The use of GM crops, in appropriate circumstances, can have considerable potential for improving agriculture and the livelihood of poor farmers in developing countries.***

- ***The possible costs, benefits and risks associated with particular GM crops can only be assessed on a case by case basis. It is important to ask the question: how does the use of a GM crop compare to other alternatives?***

- ***There is an ethical obligation to explore the potential of GM crops responsibly. We therefore recommend that research into GM crops be sustained, and especially directed towards the needs of small-scale farmers in developing countries.***

Copies of the Discussion Paper are available to download from the Council's website: www.nuffieldbioethics.org

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