

# Briefing

## GM Crops and Food Security

### The challenge

With predictions that the global population will rise from seven to nine billion by 2050<sup>i</sup>, political attention is focused on how to feed people in the future within a context of growing demand and resource scarcity. Key factors include changing diets, the impacts of climate change<sup>ii</sup>, limits on land availability, water shortages<sup>iii</sup>, soil degradation<sup>iv</sup>, declines in fisheries<sup>v</sup>, nitrogen and phosphate pollution<sup>vi</sup>, rising costs of inputs, and a need to protect biodiversity<sup>vii</sup>.

The often repeated prediction by the UN Food and Agriculture Organisation (FAO) that we need to increase food production by 60 per cent has led to claims that genetically modified (GM)<sup>viii</sup> crops are necessary to help meet this goal.

This briefing focuses on the question of whether GM crops have a role to play in meeting future food needs and sets out Friends of the Earth's position in this area. It is not an attempt to discuss all the issues and risks posed by the introduction of GM crops (including segregation from and contamination of conventional crops, economic impact on farmers, environmental and food safety, liability and food labelling).

### Why are people going hungry now?

The world currently produces more than enough food for everybody<sup>ix</sup> yet a billion people still go hungry. The main reasons for this are complex and include:

- The impact on crops of extreme weather events brought about by climate change – such as crop failures due to drought or flooding – and the knock-on effect this has on food prices.
- Food prices are also being driven-up by speculators in the money markets<sup>x</sup> leading to poorer families being unable to buy food.
- Lack of access - either because of inadequate income, or difficulties acquiring land to grow food for families and communities<sup>xi</sup>. This has been exacerbated by land grabbing – the large scale appropriation of land from small-scale food producers by foreign Governments and corporations.
- The inefficient use of crops, such as soy and grain, to feed animals, particularly in factory farms.

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For more than 40 years we've seen that the wellbeing of people and planet go hand in hand – and it's been the inspiration for our campaigns. Together with thousands of people like you we've secured safer food and water, defended wildlife and natural habitats, championed the move to clean energy and acted to keep our climate stable. Be a Friend of the Earth – see things differently.

- Unsustainable patterns of food consumption, particularly in rich countries, especially the trend for diets with increased meat and dairy. This is also contributing to severe health problems, including over a billion people being overweight or obese.<sup>xii</sup>
- Competing use of food crops to produce biofuels<sup>xiii</sup> instead of stronger requirements on car manufacturers to produce more efficient vehicles (including electric cars).
- The huge amount of food that is wasted. A third of all food produced for human consumption is wasted, either post-harvest (e.g. poor storage, mainly in developing countries) or post-consumption (especially in developed countries).<sup>xiv</sup>
- Years of dis-investment in agriculture in the poorest countries around the world and a trade regime that has promoted monoculture crops for export markets over local food production. Monocultures are also less resilient and more vulnerable to pests and disease than more diverse cropping systems.

It is clear that increasing food production alone will not address these complex challenges. And as we will see below, the GM crops currently in commercial use and proposed for use in the near-term (e.g. the next five years) are ill-equipped to be a significant part of the solution.

### **GM crops – the current reality**

GM crops are still the exception rather than the norm in global farming. GM crops cover only 3 per cent of agricultural land and this is nearly all in industrial farming systems in North and South America with some cotton in India and China. All of the world's main staple food crops – wheat, barley, oats, rice, potatoes, and all fruit and veg (with the exception of some papaya in Hawaii) is still non-GM.

According to industry sources, just two traits (herbicide tolerance and insect resistance) and four crops (soya, maize, cotton and oilseed rape) dominate commercial growing – making up 99 per cent of the GM crops planted<sup>xv</sup>. These crops have mainly been developed for large-scale commodity cultivation and export markets, mainly to feed intensively produced livestock, for biofuels and for cotton production.

Their introduction has come with significant environmental and social impacts from increased pesticide use, and patents that restrict choice and innovation and lock small farmers into debt. Furthermore, they exacerbate the problems associated with intensive production outlined above by further facilitating the use of an intensive monoculture model of production.

#### *GM herbicide tolerant crops*

The dominance of GM herbicide tolerant crops in the US has come at a price: a crisis of 'superweeds' resistant to glyphosate and other herbicides<sup>xvi</sup>. The crops have spread due to favourable policies which have allowed a very small number of companies to control the market for seeds and chemicals and because they held out promises of better weed control and cheaper crop management.

Glyphosate is the active ingredient in Roundup - the herbicide used with Monsanto's herbicide tolerant 'Roundup-Ready' crops. In the US 11 species of weeds are now resistant to glyphosate<sup>xvii</sup> as a result of over-reliance on this one herbicide. This is causing serious weed management problems for farmers as they struggle to deal with resistant weeds.

The response by the GM industry has been to encourage the use of stronger formulations of glyphosate<sup>xviii</sup> or mixtures of glyphosate and other chemicals<sup>xix</sup>, as well as to develop GM crops with resistance to more than one herbicide<sup>xx</sup>. This approach exacerbates the chemical treadmill - a worrying trend given the growing body of scientific evidence showing harm to human health and the environment caused by glyphosate<sup>xxi</sup>.

### *GM insect resistant crops*

Although the focus of this briefing is food, it is worth a quick look at the main GM crop that has been marketed to, and claimed to benefit, poor farmers - Monsanto's Bt cotton in India and China.

Bt crops produce their own insecticide targeted at some cotton pests, which is supposed to replace the need for applying insecticides to control them. However, research from 2010 found that Bt as a pro-poor technology has been mis-sold<sup>xxii</sup>. Yields are variable, pesticide use is affected by many different factors, and it is wealthy farmers that tend to benefit as they are able to afford irrigation and inputs. The author concludes "*a misleading impression has been created in public and policy discourse that Bt cotton has already proved its value as part of a sustainable, productive agricultural livelihood for poor farmers in China, India and South Africa.*"

Furthermore, evidence is emerging that reductions in pesticide use can be short-lived, particularly because of the need to control the emergence of secondary pests (pests whose predators were controlled by the Bt crops)<sup>xxiii</sup>.

### **No evidence that GM will deliver**

Science has an important role to play in tackling the challenges of global food production, but is the vast amount of money being spent on GM research<sup>xxiv</sup> justified?

Examples of GM crops attempting to be developed include drought and salt tolerant crops, nitrogen fixation and crops with altered photosynthesis. Millions of dollars of research funding is now being put into these areas of GM crop development by wealthy private donors such as the Gates foundation<sup>xxv</sup> as well as by governments and research institutions.

Whilst in theory some of these crops may help mitigate climate stresses and improve crop yields, they are probably decades away if they can be delivered at all. And in some cases other factors may be more significant than the problem the GM crop is attempting to address. For example nitrogen fixing is unlikely to increase yields in the North on its own as sufficient (and sometimes excessive) nitrogen is already applied to crops<sup>xxvi</sup>. In the South nitrogen fixing by any means will help yields, but phosphate is often the limiting factor.

Furthermore, these GM crops could exacerbate industrial farming. For example, nitrogen fixing crops could result in farmers adopting shorter crop rotations which is likely to worsen soil fertility, disease and weed problems.

### *GM drought tolerant maize*

For example, the development of GM drought tolerance has been slow and not very successful. Although Monsanto's GM 'drought tolerant' maize was approved for commercial

growing at the end of 2011 in the US, the US Department of Agriculture noted that the crop was no better than non-GM maize at coping in drought conditions<sup>xxvii</sup>.

One of the reasons these new developments have failed to materialise commercially to date is the sheer number of genes involved in mechanisms such as water use, the intricate ways in which they work, and the complex interactions between genes and their environment. This is in contrast to the relatively simple single-gene modifications of commercially grown herbicide tolerant and insect resistant crops. Discussing these different options, the Royal Society commented that all these approaches are ‘long term’ and that advances in genetic research had only lead to the prospect becoming “*less fanciful*”, rather than likely.<sup>xxviii</sup>

### *Increasing crop yields?*

GM crops have also not boosted yields. Most yield improvements in GM varieties continue to be developed primarily through conventional breeding, with the GM traits inserted into these new varieties. The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), concluded that evidence of yield gains from GM crops were anecdotal and variable, with yield gains in some locations, and yield losses in others<sup>xxix</sup>. In other words no different from the normal variation in yields expected in conventional crops under differing conditions.

Important questions need to be asked about the role of new technological approaches, who controls and benefits from them, the priority given to them in decisions over research funding, and whether they can help move us towards a more sustainable and equitable food system.

### **What role for science?**

Traditional crop breeding approaches, sometimes enhanced and accelerated through the use of genetic mapping, can work much faster. For example, drought tolerant maize varieties have already been developed through conventional breeding<sup>xxx</sup>. And researchers in Mexico have found that a successful strategy for small farmers is to help them select and improve their own traditional varieties as climatic conditions change, making use of the genetic diversity found in traditional varieties<sup>xxxi</sup>.

Friends of the Earth supports some technological approaches as a supplementary action to tackling the main causes of hunger. For example, marker assisted selection - a technique to rapidly identify useful genes in wild ancestors of crop plants to help produce crops with useful characteristics by conventional breeding.

But plant breeding techniques can only go so far. The most comprehensive scientific assessment of global agriculture published in 2008<sup>xxxii</sup> – by 400 scientists over 3 years – concluded that business as usual is not an option. It advocated a radical shift in farming practice, research and development to strengthen and benefit small-scale producers, particularly women, through boosting knowledge and local food systems, rather than intensive, export-led, agriculture, including GM crops.

More research is urgently needed into improving non-intensive food systems, such as mixed-cropping and mosaic farming – as these look considerably more promising in terms of yield, biodiversity, resilience and sustainable use of soil and water. Research should focus on multi-functional solutions that bring multiple benefits, for example wild flower margins

assist biological control, feed and shelter pollinators and farmland birds, store carbon and water and help prevent soil erosion.

### The way forward

Research for Friends of the Earth and Compassion in World Farming shows that we can feed a growing global population a nutritious diet without environmentally damaging factory farms and GM crops<sup>xxxiii</sup>. But achieving this, particularly in the context of global temperature rises and other climate change impacts, will require big changes to the way food is produced, distributed and consumed – and to the political and economic forces that drive this.

The goal should be to provide sustainable diets for all whilst living within environmental limits. The UN has defined sustainable diets as<sup>xxxiv</sup> “...*those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations...[they are] protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources*”.

We have identified ten measures that policy makers and researchers should focus on in order to provide food security and sustainable diets for all, now and in the future:

1. Aim to keep global temperature increases to less than 2 degrees. Greater temperature increases, which will lead to more extreme weather events, could devastate crop yields and livestock production in many places.
2. Change levels of consumption and promote sustainable diets - critical and significant to reduce greenhouse gases. Reducing meat and dairy will particularly reduce inefficient use of crops for animal feeds. Reducing fish consumption can help restore fisheries to boost future yields, and tackling junk food consumption will enhance public health as well as reduce pressure on crops.
3. Reduce food waste pre and post-harvest, (e.g. through improved food storage and transport systems and better infrastructure) and post consumption.
4. Enhance yields and increase resilience to climate change impacts through protecting soils, diversification and biodiversity. This means a move towards agroecology and away from monocultures, and the re-integration of animals into the farming cycle – an important step in restoring soils in many areas, and halting agricultural expansion into biodiversity rich areas.
5. Scrap mandates for biofuel production from food crops. Instead develop efficient vehicles, including electric cars and enhance public transport.
6. Increase nutrient and water resource efficiency (e.g. through drip irrigation and mixed cropping, including crop rotations with legumes).
7. Ensure low-income access to seeds, land and food, and control land grabbing.
8. Enable and encourage countries to have greater focus on meeting local and regional food needs rather than promoting export-led agriculture.
9. Provide agricultural extension services so farmers can access and implement knowledge that will enable them to farm more sustainably, and ensure that farmers are involved in developing research programmes.
10. Control financial speculation on food crops and control supermarket and retail buying power where it harms worker, farmer and other suppliers' abilities to farm sustainably.

## Conclusions

The current GM crops in use and those that are available in the near term are not designed with sustainable diets and sustainable agriculture in mind. Too much funding and political attention is being given to GM research, at the expense of cheaper, safer and simpler approaches that can deliver now for small farmers. Traditional crop breeding, enhanced by our understanding of genetics, is more promising for delivering crops suitable for sustainable agriculture and sustainable diets.

The current political and policy focus on GM crops as a solution to meeting future food needs is an expensive and dangerous distraction from addressing the more important and complex issues affecting food security, developing and supporting more sustainable and affordable farming approaches that are already delivering and addressing wider food access issues.

<sup>i</sup> United Nations 2011 [http://esa.un.org/wpp/Other-Information/Press\\_Release\\_WPP2010.pdf](http://esa.un.org/wpp/Other-Information/Press_Release_WPP2010.pdf)

<sup>ii</sup> Ackermann and Stanton (2011), Climate Economics – the state of the Art, Stockholm Environment Institute US Center

<sup>iii</sup> Millennium Ecosystem Assessment, 2005; Mapplecroft, Water Stress Index 2012

<sup>iv</sup> British Society of Soil Science;

<sup>v</sup> Srinivasan et al (2012), Marine Policy 36 (2012) 544–549

<sup>vi</sup> European Nitrogen Assessment Sources, Effects and Policy Perspectives (2011) <http://www.nine-esf.org/node/342>

<sup>vii</sup> University of California - Berkeley. "Evidence of impending tipping point for Earth." ScienceDaily, 6 Jun. 2012. Web. 24 Jul. 2012 <http://www.sciencedaily.com/releases/2012/06/120606132308.htm>

<sup>viii</sup> GM crops are defined as set out in European legislation: "genetically modified organism (GMO) means an organism...in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination"  
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:106:0001:0038:EN:PDF>

<sup>ix</sup> Address by Jaques Diouf, Director General of the FAO, World Food Day 2007  
<http://www.fao.org/newsroom/common/ecg/1000680/en/speech.pdf>

<sup>x</sup> February 2012, The Food Crises: Predictive validation of a quantitative model of food prices including speculators and ethanol conversion <http://necsi.edu/research/social/foodprices/update/>

<sup>xi</sup> FAO Hunger Portal <http://www.fao.org/hunger/en/>

<sup>xii</sup> See UN's High Level Panel of Experts on Food Security and Nutrition which expressed major concern on these issues  
[http://www.fao.org/fileadmin/user\\_upload/hlpe/hlpe\\_documents/HLPE-price-volatility-and-food-security-report-July-2011.pdf](http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE-price-volatility-and-food-security-report-July-2011.pdf)

<sup>xiii</sup> *ibid*

<sup>xiv</sup> Global food losses and food waste FAO 2011. [http://www.fao.org/ag/ags/ags-division/publications/publication/en/?dyna\\_fef%5Buid%5D=74045](http://www.fao.org/ag/ags/ags-division/publications/publication/en/?dyna_fef%5Buid%5D=74045)

<sup>xv</sup> ISAAA 2010 <http://www.isaaa.org/resources/publications/briefs/42/default.asp>

<sup>xvi</sup> <http://www.reuters.com/article/2012/05/10/us-agriculture-weeds-idUSBRE8491JZ20120510>

<sup>xvii</sup> Herbicide Tolerance and GM crops – GM Freeze, June 2011.

[http://www.gmfreeze.org/site\\_media/uploads/publications/Herbicide\\_tolerance\\_and\\_GM\\_crops\\_lo\\_res.pdf](http://www.gmfreeze.org/site_media/uploads/publications/Herbicide_tolerance_and_GM_crops_lo_res.pdf) Data from International survey of herbicide resistant weeds <http://www.weedscience.org/>

<sup>xviii</sup> See for example Monsanto's Roundup Weathermax [www.monsanto.com/products/Pages/roundup-weathermax-herbicide.aspx](http://www.monsanto.com/products/Pages/roundup-weathermax-herbicide.aspx)

<sup>xix</sup> Monsanto, Management guide for Marestail. March 2010  
[www.monsanto.com/weedmanagement/Documents/Marestail.pdf](http://www.monsanto.com/weedmanagement/Documents/Marestail.pdf)

<sup>xx</sup> Monsanto 2010 <http://monsanto.mediaroom.com/index.php?s=27632&item=77239>

<sup>xxi</sup> Duke SO and Powles SB, 2008. "Glyphosate: A once-in-a-century herbicide". *Pest Management Science* 64: 319-325

<sup>xxii</sup> Glover D, Is Bt Cotton a pro-poor technology? A review and critique of the empirical record. *Journal of Agrarian Change*, Vol. 10 No. 4, October 2010, pp. 482–509.

<sup>xxiii</sup> Wang et al (2008), Bt-cotton and secondary pests, *International Journal of Biotechnology*:10, 2 p113-121  
<http://inderscience.metapress.com/content/F5R830Q1LT175141>

<sup>xxiv</sup> Friends of the Earth is not against research on GM crops but is sceptical on their potential to deliver and cautious about their wider environmental impact. Too little is known about the interaction of inserted genes with the environment to risk releasing GM crops into the open air. There have also been numerous instances of experimental GM crops accidentally entering the food chain (eg the GM rice contamination incident in the US where an experimental GM variety contaminated global rice supplies). As such, we believe that any research should be carried out in enclosed conditions.

<sup>xxv</sup> For example <http://www.gatesfoundation.org/grants-2012/pages/john-innes-centre-opp1028264.aspx>

<sup>xxvi</sup> GM Freeze, (2012) GM Nitrogen fixing cereals: no silver bullet  
[http://www.gmfreeze.org/site\\_media/uploads/publications/N\\_fixing\\_cereals\\_final.pdf](http://www.gmfreeze.org/site_media/uploads/publications/N_fixing_cereals_final.pdf)

<sup>xxvii</sup> USDA (2011) Monsanto Company Petition (07-CR-191U) for Determination of Non-regulated Status of Event MON 87460 Draft Environmental Assessment APHIS

<sup>xxviii</sup> Royal Society (2009) Reaping the benefits p34

<sup>xxix</sup> IAASTD (2009) Agriculture at a crossroads – synthesis report p 8

<sup>xxx</sup> See examples from the International Maize and Wheat improvement Centre <http://dtma.cimmyt.org/index.php>

<sup>xxxi</sup> Mercer KL, Perales HR & Wainwright JD (2012) Climate change and the transgenic adaptation strategy: Smallholder livelihoods, climate justice, and maize landraces in Mexico *Global Environmental Change* Vol 22 pp 495-504

<sup>xxxii</sup> The International Assessment of Agriculture Science and Technology for Development (IAASTD)

[www.agassessment.org](http://www.agassessment.org)

<sup>xxxiii</sup> Eating the Planet [http://www.foe.co.uk/resource/briefings/eating\\_planet\\_briefing.pdf](http://www.foe.co.uk/resource/briefings/eating_planet_briefing.pdf)

<sup>xxxiv</sup> UN FAO - Report of the International Symposium on Biodiversity and Sustainable Diets 3-5 November 2010  
<http://www.fao.org/ag/humannutrition/28506-0efe4aed57af34e2dbb8dc578d465df8b.pdf>