

The Bill and Melinda Gates Foundation, Biotechnology and Intensive Farming

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Introduction

This briefing examines the agricultural research and development (R&D) priorities of the Bill and Melinda Gates Foundation (hereafter referred to as the Gates Foundation) including support for genetically modified (GM) crops. It assesses whether these meet either the needs of the people they claim to help or reflect the recommendations of specialist reports from UNEP/UNCTAD and IAASTD on best practice for addressing current and future food requirements and restore essential ecosystems. It does not cover other programmes of the Gates Foundation on other aspects of development, public health and education.

Background

The Gates Foundation has recognised that solutions to hunger and malnutrition are not easy, saying, *“Having enough nutritious food to feed a growing population is a complex challenge; there’s no silver bullet.”*¹

However the Gates Foundation approach to agricultural research appears to rely very heavily on “silver bullets”. In particular the Gates Foundation is keen to promote its backing of GM crops as part of the solution to global hunger by making a number of claims² including that transgenic approaches:

- Offer promising solutions to farmers facing difficult growing conditions.
- Could help improve the health of millions.
- Will create new, affordable varieties for small farmers in the developing world.
- Show no scientifically confirmed cases of harm to human health or the environment.
- Offer direct benefits to people and the environment.
- Use local involvement and farmer choice as project cornerstones.

GM proponents have used many of these arguments before.^{3 and 4} These claims have been rigorously contested by others, outside the biotechnology industry.^{5 and 6} Despite three decades of development GM traits have not had a major impact on yield,^{7 and 8} and no GM crops specifically designed to benefit health are commercially available.⁹

Instead the majority of GM crops are either tolerant to herbicides (mostly to glyphosate) or resistant to certain insect pests.¹⁰ Weed and insect resistance are undermining the effectiveness of these GM traits in many areas where they are grown. For example in the US weeds resistant to glyphosate (the active ingredient in Monsanto’s Roundup) are reported to now cover 11 million acres (4.5 million hectares).¹¹ The net result of this rapid growth in resistance is an increase in costs and complexity of weed control in GM and non-GM crops, a complete contradiction to Monsanto’s advertising hyperbole when these crops were first marketed in the 1990s. Farmers wishing to purchase traditionally-bred soya, maize and cotton seeds in the US often find them difficult to obtain because of Monsanto’s dominance over seed supply, which is currently the subject of a US Justice Department investigation into corporate concentration in agriculture.¹²

Two claims by the Gates Foundation regarding the accessibility and low cost of GM seeds are specific to their programme, but the Foundation fails to explain how long its offer to subsidise small farmers will last. It also fails to answer whether at some stage commercial GM seed companies will move in and take over the markets, which will gradually increase seed prices, particularly as the biotech corporations involved are unlikely to relinquish their intellectual property rights on any of GM traits used.

The Gates Foundation also promotes other aspects of intensive farming to small farmers in Africa including the distribution of subsidised artificial fertiliser, pesticides and hybrid seeds through co-

operation with other organisations, such as the Alliance for a Green Revolution for Africa (AGRA) and the African Agricultural Technology Foundation (AATF).

The Gates Foundation and DFID

In February 2011 the UK Department for International Development (DFID) and The Gates Foundation announced:

“[A] co-ordinated effort to reduce hunger and poverty in developing countries by supporting agricultural research projects to help small farmers increase their yields and incomes. DFID and the foundation will work together to identify the projects, and the foundation’s Agricultural Development initiative will manage them.

“DFID is contributing approximately US\$32 million (£20 million) over the next five years to this partnership, and the foundation is providing US\$70 million (£44 million). Funding will support efforts that quickly put new technologies into the hands of small farmers, such as new seeds and robust, low-cost diagnostic tools; advance existing efforts by researchers, crop breeders, and development programs to help small farmers manage crop diseases and grow more nutritious crops; and support agricultural research that promotes cutting-edge scientific innovations.”¹³

DFID is keen to emphasise that their Strategic Collaboration Portfolio with the Gates Foundation is about “sustainable intensification” and aims “to develop new technologies for use by small farmers that will accelerate sustainable intensification through increased agricultural productivity”.¹⁴

DFID has a history of collaboration or co-funding with the Gates Foundation including:

- Microfinance initiatives through the Consultative Group to Assist the Poor.¹⁵
- African Agricultural Technology Foundation, which exists to “promote...delivery of appropriate proprietary agricultural technologies for the use of resource-poor smallholder farmers”.¹⁶

The Gates Foundation and corporate collaboration

Agricultural projects funded by the Gates Foundation frequently involve collaboration with agri-biotech corporations (see also Table 1 below), for instance:

- AATF’s project on Striga control is also supported by BASF.¹⁷
- AATF’s project on cow peas is supported by Monsanto.¹⁸
- AATF’s water efficient maize involves Monsanto.¹⁹
- CIMMYT’s (the International Maize and Wheat Improvement Centre in Mexico) project on nitrogen efficient maize involves Pioneer and DuPont.²⁰
- Harvest Plus is supported by the Syngenta Foundation.²¹

Monsanto and Pioneer are listed as “sub contractors” in the projects funded by the Gates Foundation (see Table 1 below). This raises the issue of who will control the patents on the GM traits in seeds being developed. The Gates Foundation says, “*These projects will be available royalty-free to farmers, who will not have to pay any additional fees to use them. It also means that farmers can save and re-use seeds and freely share planting material.*”²² As pointed out above, this statement begs the questions for which farmers and for how long will this arrangement continue, as well as what other contractual obligations (for instance purchase of proprietary agrochemical) may be attached to such “free” use.

Swimming against a tide of informed opinion

In 2008 a major review of agricultural development, economics, trade, science and technology was published after four years of research and analysis by a cross-discipline group of 400 experts sponsored by the UN, World Bank and a number of governments (including the UK). The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) report provided a comprehensive assessment of food production and issued 22 key

findings, including a very clear recommendation that the current approach to agriculture should radically change in order to cope with climate change, soil depletion and erosion and shortage of resources:

“An increase and strengthening of [agricultural knowledge science and technology] towards agroecological sciences will contribute to addressing environmental issues while maintaining and increasing productivity.”²³

The IAASTD report also recommended that agricultural policies should be more inclusive and equitable:

“Greater and more effective involvement of women and use of their knowledge, skills and experience will advance progress towards sustainability and development goals and a strengthening and redirection of AKST [agricultural knowledge, science and technology] to address gender issues will help achieve this.”

Since the IAASTD was published several other reports have repeated the need to adopt agroecological methods.^{24,25, 26, 27 and 28}

What is agroecology?

Agroecology is the use of ecological concepts and principles to study, design, and manage agricultural systems. The five main principles are:

- recycling of nutrients
- building of soil organic matter
- minimising losses from the system
- maximising biodiversity and genetic diversity
- and enhancing biological interactions²⁹

The Gates Foundation appears to have adopted its own unique approach to agricultural development in Africa. It has not heeded the growing body of world opinion that is strongly recommending a shift away from fossil fuel based inputs toward a food sovereignty system which uses local resources, farmer knowledge and skills and newly-developed management techniques to build soil fertility, equity, local markets and social justice.

The Gates Foundation R&D expenditure

The Gates Foundation is far more open about how and where it allocates grants than some other organisations working in development (for instance DFID³⁰). The Gates Foundation publishes a list of agricultural research and development projects on its website,³¹ which gives details of expenditure on each project, the institutions receiving the funding, the total budget, period covered and a brief description of the work to be undertaken. This document also acknowledges where transgenic technology has been supported by Gates Foundation grants. However at least one grant for transgenic R&D is not currently listed by the Gates Foundation (GM bananas at the Queensland University of Technology).

Between 2005 and 2011 the R&D expenditure committed by the Gates Foundation was US\$521,469,591. Some of the grants cover the period up until 2017, for instance the UK's Biotechnology and Biological Sciences Research Council (BBSRC) has received US\$8 million for 2010-17 for “Sustainable Crop Production Research for International Development”. Other projects have been completed already.

The Gates Foundation's R&D funding and GM

The Gates Foundation acknowledges in one of three ways where the use of transgenics is involved in research and development:

- “A portion of this grant funds research that uses transgenic breeding”.
- “A portion of this grant funds research that uses transgenic approaches”.
- “A number of the projects funded by this partnership will use transgenic breeding as a research tool”.

These categories suggest that some or all of the outputs of the projects will be GM seeds, although in the case of the third this is not entirely clear.

The Gates Foundation agricultural R&D expenditure since 2005 on projects that will generate GM seeds amounts to US\$161,848,350 and US\$52,067,231 for those using transgenics as a “tool”. The total expenditure on research involving transgenic techniques is therefore US\$213,915,581. This amounts to 41% of the Gates Foundation total R&D expenditure on agriculture. Projects in which GM crops are very likely to be the outputs amounts to 31% of the total R&D spend since 2005.

Many of the promised benefits of GM crops (eg, higher yields, improved nutrition, drought and saline tolerance and nitrogen fixation) have yet to emerge from laboratories. Some have been described as “high risk”³² (such as nitrogen fixing wheat). The genetic complexity of such changes may mean it is decades before they are achieved, if at all. The high proportion of expenditure on transgenics is therefore misguided since other approaches to plant breeding (such as MAS) offer greater levels of promise sooner and with less risk.

Marker Assisted Selection (MAS)

MAS combines traditional plant breeding and molecular biology. Plant breeders identify molecular markers linked to the locus of a gene for a desirable trait on a chromosome of the parent plant. The DNA sequence of the marker can be identified in the progeny to ensure that the desirable trait has been passed on without the need to examine the physical or chemical characteristics of the next generation. MAS makes traditional breeding quicker and more precise.

Examples of successful application of MAS include:

- A project to introduce resistance for downy mildew into pearl millet in India took just three years to develop new varieties.³³
- A project to develop drought tolerant rice in India and Nepal.³⁴
- Publicly funded wheat project in the US, mainly focused on disease resistance.³⁵

Types of GM projects funded by the Gates Foundation

Table 1 shows all the projects the Gates Foundation lists as involving the use of transgenic techniques. These projects cover crop disease resistance, biofortification, nitrogen uptake efficiency and drought tolerance.

Table 1 GM projects funded by the Gates Foundation 2005-2011

Institution	Project title	Period covered	Grant	Summary description	Biotech industry involved?
African Agricultural Technology Foundation	Water Efficient Maize for Africa (WEMA)	2007-13	US\$37,758,829	Drought-tolerant maize varieties to benefit smallholder African farmers in five countries	Monsanto is a sub-contractor to AATF on this grant.
Centro Internacional de Mejoramiento de Maiz y Trigo	Improved Maize for African Soils (IMAS)	2009-14	US\$17,309,632	Nitrogen efficient maize adapted to Africa's nitrogen-deficient soils	Pioneer is a subcontractor to CIMMYT on this grant.
Donald Danforth Plant Science Center	BioCassava Plus	2011-14	US\$5,157,560	Cassava with enhanced levels of beta carotene and iron for small farmers in Nigeria, and with beta carotene, iron, and protein for small farmers in Kenya	
International Food Policy Research Institute	HarvestPlus II	2009-13	US\$45,000,000	Biofortified staple crops, including maize, sweet potato, beans, millet, cassava, rice, and wheat, to reduce micronutrient deficiencies in developing countries. This phase of work focuses on crop improvement, nutrition retention, and efficacy studies, collaborating with institutions.	
International Food Policy Research Institute	HarvestPlus Bridge	2007-08	US\$8,850,000	Financed a bridge year for HarvestPlus to transition to a product-focused approach and supported the research and development of biofortified staple crops for developing countries	
International Institute of Tropical Agriculture	Cassava Brown Streak Disease Resistance	2009-13	US\$2,424,683	Supports national research institutes in Uganda and Tanzania to develop new varieties of cassava that are resistant to Cassava Brown	

				Streak Disease	
International Rice Research Institute	Golden Rice	2011-14	US\$8,787,000	Developing local varieties of rice that contain beta carotene	
International Rice Research Institute	C4-Rice	2008-12	US\$11,017,675	To increase rice yields and decrease the amount of water and fertilizer needed to grow by speeding up the photosynthesis process in the plant	
Queensland University of Technology*	Biofortified banana	2005-09	US\$3,946,708	To develop bananas with increased micronutrient content	
Regents of the University of California, Davis	Generation of Wheat Resistant to Multiple Rust Diseases Using RNAi	2009-11	US\$346,263	To engineer wheat rust immunity based on molecular understanding of the disease and ultimately develop wheat varieties that are resistant to rust diseases	
The International Potato Center	Sweet potato Action for Security and Health in Africa (SASHA)	2009-14	US\$21,250,000	To produce high-yielding, locally adapted varieties of sweet potato that are resistant to weevils and have increased levels of vitamin A	
Total			US\$161,848,350		

* NB this grant was not listed in the main document on the Gates Foundation website.

The Gates Foundation also funds three other projects using transgenic breeding as a research tool (see Table 2). These are looking at disease resistance and a general fund to look for novel approaches to farming problems in Sub-Saharan Africa, which could involve the production of GM crops as an output or non-GM crops or approaches.

Table 2 Projects funded by the Gates Foundation where transgenics is used a research tool

Institution	Project title	Period covered	Grant	Summary description
Cornell University	Durable Rust Resistance in Wheat (DRRW), Phase I	2009-12	US\$26,830,848	Improved rust resistant wheat varieties, funding planning and advocacy efforts, investigating different approaches to durably protecting wheat plants from rust diseases, and supporting disease screening facilities in Kenya and Ethiopia
Mikocheni	Cassava	2008-11	US\$1,236,383	improved understanding of Cassava

Agricultural Research Institute	Diagnostics Research Program			Mosaic Disease and Cassava Brown Streak Disease, using detailed surveillance maps and diagnostic tools. The project strengthens eastern and southern African research institutions to develop sustainable solutions to controlling these viruses.
National Science Foundation	Basic Research to Enable Agricultural Development	2009-15	US\$24,000,000	This competitive award program solicits novel ideas that offer the potential to solve critical problems impacting smallholder farmers in Sub-Saharan Africa.
Total			US\$52,067,231	

The project on rust resistance in wheat at Cornell University is being funded through the collaboration between the Gates Foundation and DFID (see above). Cornell is to receive US\$40 million (£25 million) for this project in addition to sum already received from the Gates Foundation (see Table 2). At present the outputs of resistant seeds appear to be non-GM. The influence DFID will have on the content and future direction of such projects is not at all clear given *“the foundation’s Agricultural Development initiative will manage them”*³⁶.

In their information on the latest collaboration with the Gates Foundation, DFID lists four plant breeding projects in the intended outputs from the joint initiative³⁷:

1. Protection for 90% of wheat grown globally from new, spreading types of virulent stem rust disease.
2. Increase in rice yields by 50% and water use efficacy by 100% by transforming rice from C3 to a C4 photosynthetic pathway.
3. Develop new varieties of maize better adapted to Africa’s nutrient deficient soils.
4. Faster genetic gains for improved yield and stress tolerance of important tropical legume crops (ie, groundnut, cowpea, common bean and chickpea).

These are described as either:

- Near market R&D, which aims to quickly get the benefits and outputs of research into widespread use to improve nutrition, food security and incomes.
- Translation of known science into technological solutions for use by researchers, crop breeders development programmes and farmers in developing countries.
- High pay-off, higher risk, high impact research on global scientific priorities.

The Royal Society describes the conversion of rice from C3 to C4 photosynthetic pathways as a “high-risk”³⁸ use of GM. It is an example of DFID and the Gates Foundation both being firmly committed to the silver bullet approach despite the fact it could ultimately prove impossible because of the complex biochemical changes in the plant which it requires. And of course neither C3 nor C4 rice would flourish in the absence of significant rainfall over an extended period of time, as is predicted under climate change.

The absence of any other approach to mitigating the effects of prolonged drought advocated by IAASTD (eg, water harvesting, soil improvements and the use of agroforestry) strongly suggests that both DFID and the Gates Foundation should consult much more widely before committing such large expenditure to GM projects which in the long run may fail.

How Gates Foundation GM R&D funding compares with other important R&D topics

The Gates Foundation claims to be taking a comprehensive approach to tackling hunger and poverty in Africa:

“We take a comprehensive approach—from investing in improved seeds and healthy soil to supporting effective farm management practices and expanding small farmers’ access to markets.”³⁹

Healthy soil appears to be a poor relation to the Gates Foundation’s other agricultural R&D priorities, which is all the more surprising given that the Gates Foundation places great emphasis on the poverty and infertility of African soils in many of their documents, for instance:

“The soils of sub-Saharan Africa are the most degraded in the world. Farmers in the region use about 10 times less fertilizer than farmers elsewhere. Together, these factors contribute to crop yields that are two to five times lower than the global average.”⁴⁰

Analysis of the Gates Foundation spending on R&D on agriculture reveals that only two soil-related projects have been funded since 2005, with total grants worth just over US\$20 million. These were:

- Meridan Institute (US\$857,391) – To research and identify technologies to improve the soil health in Sub-Saharan Africa and South Asia. It aimed to identify at least two promising technologies for further investment and development, as well as describe the risk and benefits of other technologies with potential.
- Wageningen University (US\$19,204,955) – To increase legume productivity, family nutrition, soil health, cropping systems, and farm income for small farmers in Burkina Faso, Mali, Nigeria, Ghana, Kenya, Rwanda, and Malawi by expanding the use of selected legumes, proven tools of biological nitrogen fixation, and sound agronomic principles.

Expenditure on soil research by the Gates Foundation therefore amounts to just 4% of the total R&D spend. These two project descriptions do not give a clear indication of what direction the Gates Foundation wishes to take regarding the stewardship of African soils. The focus on nitrogen fixing crops in the Wageningen project is welcome, but there are many more promising agroecological techniques that could also be supported, for instance⁴¹:

- Nitrogen fixing trees and shrubs.
- Using minimum tillage methods during dry-season.
- Retention of crop residues from the prior harvest rather than burning them.
- Targeted planting and application of farm inputs in restricted fixed locations.
- Practicing crop rotations using nitrogen-fixing plant species.
- Growing green manure and dual purpose legumes.
- Applying animal manure and compost.

Many of these techniques are being applied by African farmers with great success⁴², but not on a wide enough scale.

However it appears that the Gates Foundation is spending a lot of money on pushing artificial fertilisers on small farmers. It has allocated over US\$164 million to the Alliance for a Green Revolution in Africa (AGRA) to improve *“African soil fertility through the use of improved soil fertility management practices and fertilizers that stably increase crop productivity”*. There is no doubt about the objectives behind this grant:

- *“The grant will also help AGRA build the fertilizer supply chain to increase farmers’ access to fertilizer and other inputs.”⁴³*
- The target for this project is *“187,000 tons of fertilizer delivered to small farmers through wholesale and retail networks by December 2012.”⁴⁴*

With the costs of fertiliser inflating, any strategy that increases dependency on inputs is questionable, particularly if hybrid seeds being distributed are more dependent on increased inputs than locally-adapted varieties.

Projects funded by other bodies have followed the agroecological approach to maintain and improve the fertility and structure of African soils using locally available resources.⁴⁵

No other agroecological research projects appear to have been funded by the Gates Foundation on the basis of what it has published.

The Gates Foundation priorities are clear – it has allocated more than eight times as much money to AGRA for a project to distribute artificial fertilizers as its main activity than to researching improved soil fertility using local resources. Funding for research involving transgenics outstrips that for soils by more than ten-fold.

The flawed approach

The approach to agricultural development adopted by the Gates Foundation appears to be based on the model used in northern developed countries by most farmers – high input of fossil fuel dependent chemicals – despite the fact that this intensive system has degraded soil, impoverished biodiversity, and polluted surface water, ground water and the marine environment (while at the same time small and family farm businesses have left the land in droves), all at the tax payers' expense.⁴⁶

This approach has many potential pitfalls. For example many parts of Africa are highly dependent on groundwater from near-surface aquifers for drinking water, which are recharged by rainfall in relatively short time periods⁴⁷, and therefore supplies are vulnerable to agrochemicals leaching. The environmental and health consequences and clean-up costs of such pollution would be enormous, as has been demonstrated in the UK where intensive industrialised agriculture has been practiced for decades and has caused such problems.^{48 and 49} In his report for the UK Environment Agency, O'Neil⁵⁰ put the overall external costs of farming in the UK due to water and air pollution and soil loss and damage to be in the range £1149 million to £3050 million. These costs include the removal of nitrate from surface and groundwater to ensure that drinking water complies with the European Drinking Water Directive's maximum permitted concentration, which has been set to protect bottle fed infants from Methemoglobinemia ("blue baby" syndrome).⁵¹

Repeating the mistakes of industrialised farming will not address either the problems that many small family farms face or the need to reverse the environmental degradation for which that type of farming is primarily responsible.

It is unclear whether those guiding the Gates Foundation strategy have fully grasped the very clear message about global farming from the IAASTD: "*Business-as-usual will not work*".⁵² It needs to do so quickly. Several studies have backed up the IAASTD's key finding that agroecological approaches could deliver real benefits:

- *"Drawing on an extensive review of the scientific literature published in the last five years, the Special Rapporteur identifies agroecology as a mode of agricultural development which not only shows strong conceptual connections with the right to food, but has proven results for fast progress in the concretization of this human right for many vulnerable groups in various countries and environments. Moreover, agroecology delivers advantages that are complementary to better known conventional approaches such as breeding highyielding varieties. And it strongly contributes to the broader economic development"* (De Shutter 2011). *Green agriculture is capable of nourishing a growing and more demanding world population at higher nutritional levels out to 2050. An increase from today's 2,800 Kcal availability per person per day to around 3,200 Kcal by 2050 is possible with the use of green agricultural practices and technologies. It is possible to gain significant nutritional*

improvements from increased quantity and diversity of food (especially non-cereal products).”⁵³

- *“Organic agriculture can increase agricultural productivity and can raise incomes with low cost, locally available and appropriate resources, without causing environmental damage. Furthermore, evidence shows that organic agriculture can build up natural resources, strengthen communities and improve human capacity, thus improving food security by addressing many different causal factors simultaneously.”⁵⁴*

Not all US philanthropists agree with the Gates Foundation approach to agriculture. At a recent World Food Prize symposium, Howard Buffett (President of the Howard G. Buffett Foundation) was reported⁵⁵ to have said, *“A ‘Green Revolution’ really won’t work for the majority of African farmers.... We need a brown revolution,” focusing on soil types.*”

He noted that two previous reports, one in 2004 commissioned by the United Nations and one in 2008 from the International Assessment of Agricultural Knowledge, Science and Technology, support his view that multiple approaches and improving soil quality were keys to fighting hunger in Africa.

If the Gates Foundation is genuinely interested in pursuing sustainable food production in Africa, or anywhere else, it should urgently reassess how it allocates its funding for agricultural research and development. Each day it fails to do so only serves to highlight more clearly where the Foundation’s priorities truly lie.

The Gates Foundation needs to be very clear how it defines sustainable farming. This surely must include not only the restoration of degraded soils, biodiversity and other natural resources, but also political, social and economic reforms aimed at securing the necessary infrastructure, education and resources to enable farmers of both genders to prosper.

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