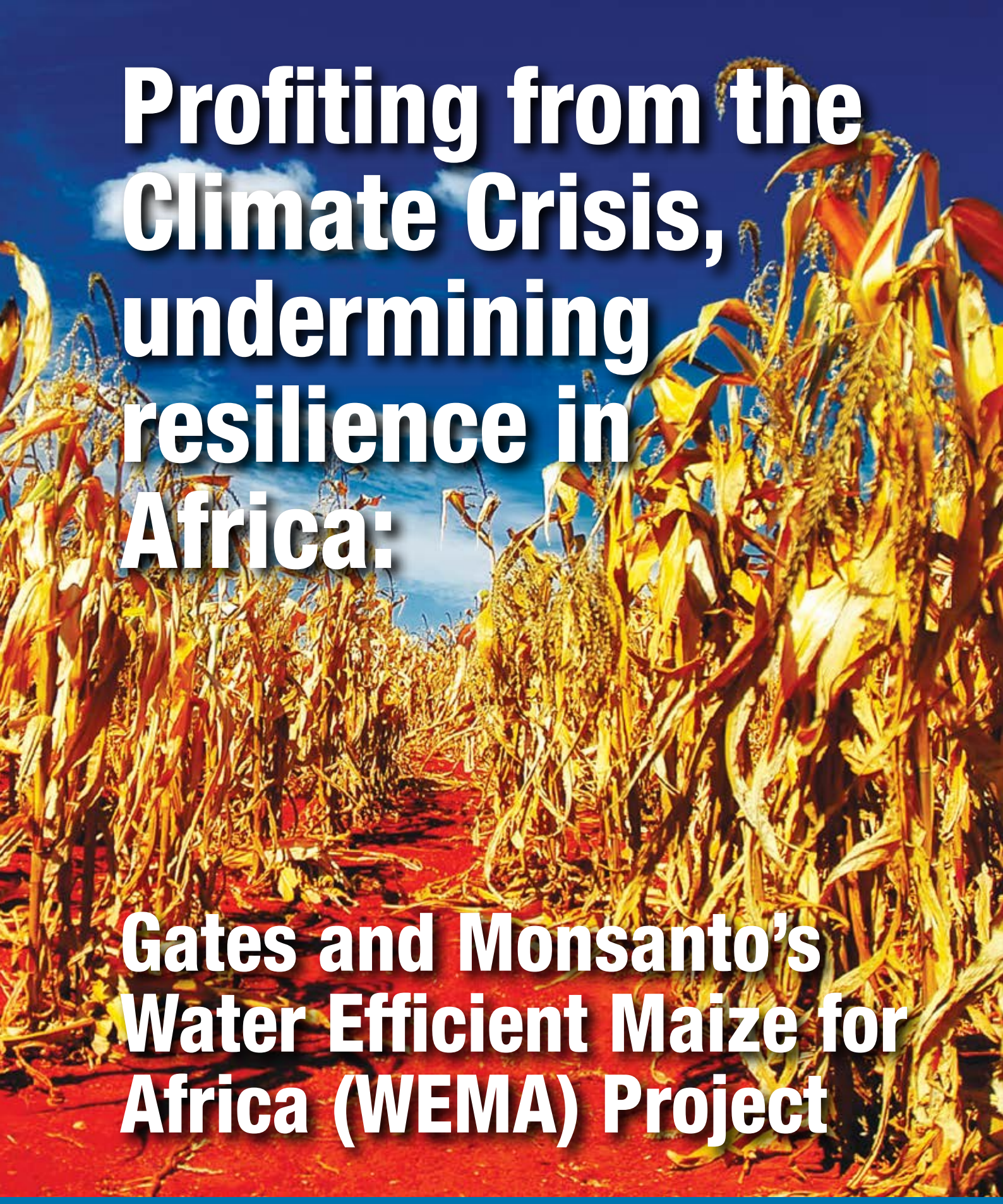

Profiting from the Climate Crisis, undermining resilience in Africa:

Gates and Monsanto's Water Efficient Maize for Africa (WEMA) Project

african centre for biodiversity

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Contents

On the 7th of April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity. This name change was decided upon by mutual consultation within the ACB to reflect the expanded scope of our work over the past few years.

All ACB publications prior to this date will continue to go under our old name of African Centre for Biosafety, and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture system in Africa and believe in peoples' right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

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Abbreviations and acronyms

AATF	African Agricultural Technology Foundation
ABNE	African Biosafety Network of Expertise
ABS	Access and Benefit Sharing
ACB	African Centre for Biodiversity
AECF	African Enterprise Challenge Fund
AFSA	Alliance for Food Sovereignty in Africa
AFSTA	African Seed Trade Association
AGRA	Alliance for a Green Revolution in Africa
ARC	Agricultural Research Council (South Africa)
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AUC	African Union Commission
BMGF	Bill and Melinda Gates Foundation
Bt	bacillus thuringiensis
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Centre
cspB	Cold Shock Protein
CSA	Climate Smart Agriculture
DANIDA	Danish International Development Agency
DfID	Department for International Development (UK)
DMTA	Drought-tolerant Maize for Africa project
DTMASS	Drought-Tolerant Maize for Africa Seed Scaling
DUS	Distinct, Uniform and Stable
EFSA	European Food Safety Authority
FISP	Farm Input Subsidy Programme
GM	Genetically Modified
HT	Herbicide tolerant
IAASTD	The International Assessment of Agricultural Knowledge, Science and Technology for Development
IITA	International Institute for Tropical Agriculture
IP	Intellectual Property
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MARS	Marker-Assisted Recurrent Selection
MT	Metric Tons
NARS	National Agricultural Research Systems

NEPAD	New Economic Partnership for Africa's Development
OPV	Open Pollinated Variety
PAIA	Promotion of Access to Information Act
PASS	Programme for Africa's Seed Systems (AGRA)
R&D	Research and Development
SANBI	South African National Biodiversity Institute
SIDA	Swedish International Development Co-operation Agency
SMTA	Standard Material Transfer Agreement
SPP	Surplus People's Project
SSA	Sub-Saharan Africa
UNCBD	United Nations Convention on Biodiversity
UNDP	United Nations Development Programme
UNFAO	United Nations Food and Agriculture Organisation
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WEMA	Water Efficient Maize for Africa project
WIPO	World Intellectual Property Office

Key findings

- Africa is likely to bear the brunt of the impacts of climate change. Mean annual temperatures will rise, as will the frequency and length of heat waves. Large parts of the continent are expected to become drier, which will have a significant impact on maize production.
- In response to this a plethora of false solutions have been proposed, such as Climate Smart Agriculture (CSA), which advocates for the use of Genetically Modified (GM) crops and carbon trading. The Consultative Group on International Agricultural Research (CGIAR), a key player in the CSA movement, has cited the Water Efficient Maize for Africa (WEMA) project as a successful case study for CSA.
- The goal of the WEMA project is to produce, using both genetic engineering and conventional hybrid breeding, drought-tolerant maize varieties for small-scale farmers in Sub Saharan Africa (SSA). WEMA is being funded (US$ 85 million so far) by the Bill and Melinda Gates Foundation (BMGF), the Howard G. Buffett Foundation and USAID. Its key partners include Monsanto, the International Maize and Wheat Improvement Centre (CIMMYT) and the national agricultural research systems (NARS) in each WEMA country (Kenya, Tanzania, South Africa, Mozambique and Uganda). Project partners have agreed to make available their best maize germplasm lines, with Monsanto 'donating' the drought-tolerant gene. Much of the germplasm from CIMMYT is the result of another BMGF funded initiative, the Drought Tolerant Maize for Africa (DTMA) project, which has worked to release both drought-tolerant Open Pollinated Varieties (OPV) and hybrid maize in 13 African countries.
- Drought tolerance in plants is an extremely complex phenomenon and evidence from the United States suggests that Monsanto's GM drought-tolerant maize will make minimal impact there. Nevertheless, under the guise of philanthropy and fighting climate change, the WEMA project is seeking to lay the groundwork for the acceptance of GM crops across the board. The inclusion of Monsanto's insect resistant trait MON810, which has largely failed in South Africa and has been shown to be completely unsuitable for small-scale farmers, is indicative of this.
- Furthermore, the WEMA project sits at the apex of efforts to completely transform African agricultural systems. Via its hybrid breeding programme, which draws upon decades of research carried out by public-sector breeders for the public good, WEMA ultimately aims to shift the focus and ownership of maize breeding, seed production and marketing almost exclusively into the private sector and, in the process, ensnare small-scale farmers in SSA into the adoption of hybrid maize varieties and their accompanying synthetic fertilisers and pesticides.
- However, these costly inputs and the sheer diversity of agro-ecological systems in SSA mean that this model will ultimately benefit only a select layer of small-scale farmers, with apparently no consideration for the majority who will be abandoned by the wayside. The costs and technical requirements of hybrid seed production are presently also beyond the reach of most African seed companies. A focus on this market will inevitably lead to industry concentration, as has happened elsewhere, enabling the big multinational agro chemical/quasi seed companies to dominate.
- The BMGF is clearly a kingpin in this transformative movement, funding, as it does, the WEMA project, the DTMA project, the Alliance for a Green Revolution in Africa (AGRA) and efforts to undermine strong biosafety legislation on the continent. However, money from taxpayers in the global north, particularly from the United Kingdom's Department for International Development (DfID), the United States Agency for International Development (USAID), the Swedish International Development Cooperation Agency (SIDA) and the Danish International Development Agency (DANIDA) has also contributed significantly to both WEMA and other Green Revolution Initiatives.

Introduction

Never let a good crisis go to waste.
Winston Churchill.

Few would doubt the magnitude of the ecological crisis we are currently facing, nor the central role of human activity, chiefly activity from the world's richest nations, inherent in the crisis. If predictions within the latest report from the Intergovernmental Panel on Climate Change are to be believed, over the remainder of this century average global temperatures will continue to rise, much of the world's coastal zones will become more prone to flooding, and many regions will become considerably drier. These trends will also be accompanied by more and more 'extreme weather' events, such as the catastrophic flooding witnessed recently in Malawi.

Africa is likely to bear the brunt of climate change, with predictions that mean annual temperatures across the continent will rise anywhere between 2°C and 6°C, and at a faster rate than other regions of the world. It is anticipated that Africa's sub-tropical regions will become drier, and the continent will be exposed to more frequent and longer heat waves. Cereal production is likely to be negatively affected across the continent as a result of climate change, with maize-based systems, particularly in southern Africa, being especially vulnerable.[1] Maize is the principle staple crop for much of SSA, accounting for 29% of the area under cereal crops in eastern Africa, rising to 65% in southern Africa (where it also contributes 30% of total calorific and protein consumption).[2]

There is near universal consensus that in response to this situation resources and attention must be channelled into agriculture in SSA, but there is a wide divergence of opinion on how this should be done. On one side are those like the international peasant movement, Via Campesina, and the Alliance for Food Sovereignty in Africa (AFSA), who have advocated for an agricultural system based on environmental sustainability, social equity and democratic participation and decision-making—which could be termed 'food sovereignty'. On the other side stand those who champion concepts such as 'sustainable intensification' or 'climate smart agriculture' (CSA).

The concept of CSA emerged from the United Nations Food and Agricultural Organisation (UNFAO) in 2010 and, according to the original definition 'sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals'. In the interim the government of the Netherlands, together with the World Bank, the government of the United States, the UNFAO and CGIAR have spearheaded the creation of a Global Alliance on CSA. The government of South Africa has also given the initiative its blessing by hosting a meeting of the Alliance in 2013.[3]

For all its rhetoric around environmental sustainability, CSA is firmly rooted within a Green Revolution paradigm in which privately owned technologies promoted by agribusiness are accepted uncritically and the free-market environmental right to pollute is available to the highest bidder. As an example, CGIAR's programme on climate change heralds the contribution of GM herbicide tolerant (HT) canola in Canada, for keeping CO^2 (a major greenhouse gas) in the soil by eliminating the need for soil tillage to remove weeds.[4] This soil-stored (or 'sequestered') carbon can then be traded as a commodity on financial markets, where major polluters in the global north, through purchasing these carbon credits, can continue polluting at will.[5]

For these reasons, in addition to the active participation of some of the world's largest agri-business corporations (including Syngenta, Yara, Kellogg's and McDonald's) in its structures, civil society has been swift in its condemnation of the Global Alliance and the principles of CSA itself. It is clear from this that the principles of CSA are fluid and malleable by those with the greatest resources; that it is being used to promote environmentally damaging technologies; and to shift the burden of climate change mitigation onto those least responsible for, yet most vulnerable to climate change. Worryingly, CSA is also gaining traction with other influential organisations, such as the Alliance for a Green Revolution in Africa (AGRA),

Monsanto WEMA countries
http://www.monsanto.com/SiteCollectionImages/WEMA-countries.jpg

which devotes a whole chapter to CSA in its latest 'Status of African Agriculture' report.[6]

Two further CSA case studies selected by CGIAR's programme on climate change, on account that they achieve the 'triple win' of adaptation, mitigation and food security, are the DTMA project and the WEMA project.[7]

The goal of the WEMA project is to produce drought-tolerant maize varieties using both conventional breeding and genetic engineering. WEMA, a public-private-partnership that has been financed primarily by the BMGF, involves multinational seed and biotechnology company, Monsanto, CIMMYT, and the National Agricultural Research Systems (NARS) of Kenya, Mozambique, South Africa, Tanzania and Uganda. So far the BMGF has pumped over US$ 85 million into the WEMA project.

More than just a staple crop, the maize model has a long history in Africa and continues to dominate much of the current Research & Development (R&D) agenda,[8] with many small-scale farmers being introduced to hybrid varieties as far back as the post-independence period.[9] In eastern and southern Africa (excluding South Africa) it is estimated that 44% of the maize area is planted with hybrid varieties, with considerable variation between countries. This history has been, and continues to be shaped by power relations and institutional interests.[10]

The role of hybrid maize (and accompanying synthetic fertiliser) has been further strengthened over the last decade by the resurgence in agricultural input subsidies across SSA, described as 'arguably the region's most important agricultural policy development in recent years'.[11] Fieldwork conducted by the African Centre for Biodiversity (ACB) in Malawi in 2014 found extremely high adoption rates of hybrid maize seed, driven in large part by that country's farm input subsidy programme (FISP). Seed Co, Pannar (owned by Pioneer Hi-Bred since 2012) and Monsanto were among the chief beneficiaries,[12] and are estimated to control over 90% of the maize seed market in Malawi.[13] In Tanzania, Pannar and Seed Co held over 50% of the maize seed market in 2010/11.[14]

Recent developments suggest further penetration of African seed markets by the

global seed industry. Limagrain, Europe's largest seed company, purchased the South African seed company, Link Seed, in 2013 and followed this with a major investment (up to US$ 60 million) in Zimbabwe's Seed Co.[15] In early 2015 Monsanto announced it was moving its African headquarters from Johannesburg to Nairobi, to be closer to its major growth markets in East Africa.[16] Under the G8 New Alliance, Pioneer Hi-Bred, Monsanto and Syngenta have all pledged to work on increasing hybrid maize adoption in G8 New Alliance countries. The continued drive to open up markets for hybrid maize seed is being paralleled by the fertiliser industry. Norwegian fertiliser giant Yara is in the process of building a US$ 20 million fertiliser terminal at the port of Dar es Salaam in Tanzania. The production of just nitrogen-based fertiliser is extremely energy intensive and accounts for 2% of total global energy demmand.[17]

This is the context in which the WEMA project should be seen and assessed. What follows is an overview of the WEMA project: we present a scrutiny of its activities on both GM and conventional hybrid drought-tolerant maize; discuss the dissemination model that WEMA is supporting; and comment briefly on issues around access to genetic resources from the public sector in public-private partnerships. We acknowledge that the complexity of this topic and commercial sensitivities around the WEMA project make it extremely difficult to draw any firm conclusions. The paper concludes with some policy recommendations on alternatives to projects such as WEMA.

The Water Efficient Maize for Africa (WEMA) Project

Drought stress is as complicated and difficult to plant biology as cancer is to mammalian biology.

Jian-Kang Zhu, molecular geneticist, University of California.[18]

The WEMA project was officially launched in Kampala, Uganda, in 2008, its ultimate goal being to release both conventional hybrid and GM drought-tolerant maize varieties in five countries in Sub-Saharan Africa (SSA). It is a joint collaboration involving the International Maize and Wheat Improvement Centre (CIMMYT), the NARS of the five WEMA countries (Kenya, Mozambique, South Africa, Tanzania and Uganda) and Monsanto, the world's largest seed and biotechnology company. The implementing agency is the African Agricultural Technology Foundation (AATF), based in Nairobi, Kenya, but registered as a charity in England and Wales.

The cost of the WEMA project's first phase was US$ 47 million, with US$ 39.1 million coming from the BMGF and the remainder from the Howard G. Buffet Foundation. In October 2012 the BMGF contributed a further US$ 48.9 million for the second phase of the project which will run until 2017. For the second phase the USAID contributed about US$ 7.5 million during 2013 and 2014.[19] Since 2004 the AATF, WEMA's implementing agency, has also received GBP 12.5 million from the United Kingdom's DfID, GBP 7.5 million of which has been granted since 2010.[20] Though it is not clear how much of this funding is earmarked for the WEMA project, it nonetheless indicates that substantial amounts of public finance are being allocated to the project.

The project has two major components: a conventional hybrid maize breeding programme using maize germplasm donated to WEMA by each of the participating parties (Monsanto, CIMMYT and the five individual NARS), and a programme focusing on producing GM drought-tolerant maize

varieties. Much of the maize germplasm donated by CIMMYT will come from an earlier breeding programme, also funded by the BMGF, called the Drought Tolerant Maize for Africa (DTMA) project. The GM component combines maize germplasm developed under WEMA with Monsanto's GM drought-tolerant maize variety, MON87460, which contains the bacterial cold-shock gene, *cspB*.

The Bill and Melinda Gates Foundation (BMGF)

The BMGF has been described as 'arguably the biggest philanthropic venture ever'. It administers a US$ 40 billion endowment, mostly from the contributions of former Microsoft Chief Executive Officer (CEO), Bill Gates, and billionaire financier Warren Buffet. Since it was established in 2000 the Foundation has conferred grants of more than US$ 30 billion.[21]

Since 2006 the BMGF has invested heavily in agriculture in Africa. It has established the Alliance for a Green Revolution in Africa (AGRA), to which it has given over US$ 400 million in the intervening period. It has also given close to US$ 100 million to the African Agricultural Technology Foundation (AATF). Between 2003 and 2014 it has contributed somewhere in the region of US$ 720 million to CGIAR, a global network of agricultural research and policy institutions.[22] The International Maize and Wheat Improvement Centre (CIMMYT), a WEMA project partner, was one of the two original members of the CGIAR system. When CGIAR was re-launched in 2010 following a substantial overhaul, the BMGF officially joined CGIAR[23] and currently sits on the CGIAR Fund Council.[24]

The BMGF's support for the WEMA project extends beyond the US$ 85.7 million granted to it so far. For example, much of the maize germplasm that WEMA will use comes from the DTMA project, to which it has given US$ 67 million. Some of the companies already involved in marketing WEMA hybrid varieties have previously received support from AGRA's Programme for Africa's Seed Systems (PASS), which the BMGF initiated with a grant of US$ 96.9 million. AGRA has also supported some WEMA partner companies via the African Seed Investment Fund (ASIF), which it established in 2010 with a grant of US$ 12 million. ASIF is managed by Pearl Capital Partners, an agricultural investment firm with offices in Kampala and Nairobi. Finally, since 2007 the BMGF has contributed over US$ 24 million for the implementation of conducive biosafety legislation on the continent, chiefly through the creation of the African Biosafety Network of Expertise (ABNE).[25]

The Bill and Melinda Gates Foundation campus, Seattle.
http://im.rediff.com/money/2012/jan/27ms1.jpg

WEMA's GM drought-tolerant maize programme

One of the greatest attributes of biotechnology is its scale-neutral applicability. The power of the technology is delivered through a seed that can be grown by any farmer, regardless of their operations and farm size, without additional equipment or large capital investment.
International Service for the Acquisition of Agri-biotech Applications (ISAAA).[26]

The modern bio-technologies coming from developed countries favour large-scale farming of a small number of mega-crops. This range of crops does not fit the type and purpose of farms of subsistence and poor farmers.
International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD).[27]

The GM component of the WEMA project is from Monsanto's GM maize variety MON87460, which contains the bacterial cold-shock gene, *cspB,* derived from the common soil bacterium *Bacillus subtilis.* According to Monsanto's general release application for MON87460 in South Africa, the *cspB* gene 'helps to preserve cellular functions during certain stresses' and 'reduces yield loss, primarily through increasing kernel numbers per ear'.[28]

MON87460 was 'donated' to the WEMA project by Monsanto from the outset. It bears repeating that it was not developed specifically for small-scale farmers in SSA but emerged from a joint US$ 2.5 billion research project between Monsanto and the German chemical behemoth BASF to develop GM drought tolerance in five of the world's major grain crops: canola, cotton, maize, soya and wheat.[29] In 2009 the CEO of Monsanto, Hugh Grant, told investors that the collaboration could potentially deliver 'an incremental US$ 3 billion in gross revenues by 2020 in the first countries of launch.'[30]

Some context is required regarding philanthropic gestures from the biotech industry. In 2014 Monsanto spent US$ 1.7 billion on R&D. Put another way, the US$ 47 million initial cost of the WEMA project's first five years is equal to about ten day's worth of the annual research budget at Monsanto. In fact, since WEMA began, Monsanto has spent well over US$ 9.3 billion on R&D.[31] MON84786 is also far from the only 'drought tolerant' gene Monsanto has in its stable. For example, a patent application submitted by Monsanto back in 2004 lists 19 other transgenic events that contain *cspB*.[32]

MON87460, or 'Droughtgard', as it is known commercially, was approved for environmental release in the United States in December 2011. At the time this was considered a coup by the biotechnology industry and Monsanto in particular, as it was the first new GM 'trait' to be introduced in GM maize outside insect resistance and herbicide tolerance.

Contrary to its highly optimistic public pronouncements, Monsanto's application for MON87460 to the United States Department of Agriculture (USDA) makes for more sober reading. MON87460, according to Monsanto's submission, 'reduces yield loss under water-limited conditions ... Like conventional corn, MON87460 is still subject to yield loss under water-limited conditions'. This reduction in yield loss is estimated to be around 6%, compared with non-GM conventional maize varieties. It is also accepted that MON87460 is 'unlikely to have any benefit under extreme conditions'.[33]

Using this information, the Union of Concerned Scientists has calculated that, assuming MON87460 is grown on the 15% of the US maize area that is drought prone, the introduction of MON87460 would result in a nationwide annual productivity increase of 1%. This is roughly the same as annual maize productivity increases in the United States resulting from conventional breeding for drought tolerance.[34]

Information on the uptake of GM drought-tolerant maize in the United States since its release in 2011 is sketchy. According to the ISAAA, an industry-backed lobby-group masquerading as an NGO, approximately 275,000 ha of Monsanto's 'Drought Guard' maize were planted in the United States in 2014, up from 50,000 ha in 2013.[35] This is still

someway short of the 5 million ha for which the USDA suggests MON87460 is suitable. That being said, Monsanto has plans to double the potential area for MON87460 cultivation by stacking it with Smartstax Pro, in the process creating a 10-gene GM maize variety.[36]

WEMA's GM status in Africa

GM crops have been commercially cultivated in South Africa since 1998 and South Africa remains the only WEMA country where this is the case. During the 2013/14 season 86% of the maize grown in South Africa was GM,[37] which translates into approximately 2.3 million ha.[38] It should be noted however that, due to the historical dispossession of land in South Africa, the majority of GM maize cultivation in the country is undertaken by large-scale, highly mechanised and capital intensive farming operations, not the small-scale farmers that the WEMA project is targeting. In this respect South Africa's agricultural system is unique in SSA. The WEMA project clearly recognises this duality in its intellectual property policy, specifying target farmers in South Africa as 'those who plant on up to three hectares of land'.[39]

The first field trials for MON87460 on African soil took place in South Africa in 2007 in Hopetown and Orania in the Northern Cape. In 2009 field trials began at three further locations, Delareyvile, Lutzville and a water-controlled cultivation plot in Pretoria. Field trials have subsequently continued on an annual basis at these sites. The ACB has previously submitted objections to these trials, in 2007,[40] 2010[41] and 2012, [42] citing a lack of biosafety data and concerns about the use of antibiotic resistant marker genes.[43]

In 2011 small-scale farmers in Lutzville in the Northern Cape submitted a formal objection to Monsanto's field trials, under the auspices of the Agrarian Reform for Food Sovereignty campaign, assisted by the Surplus People's Project (SPP).[44] The concerns of local farmers in this case were dismissed as being largely emotional and unscientific, a catch-all term frequently used against those who question the safety or efficacy of GM crops, even those among the scientific community.[45]

In July 2014 Monsanto submitted an application for full environmental release of MON87460. At the time of writing this has yet to be approved; the South African GMO Registrar stated that the application was 'under review'.[46] There is no mention of MON87460 in the latest published South African GMO permits (for March 2015). However, Monsanto appears confident that its application will be successful, having commenced field trials of three further GM maize varieties containing MON87460: MON87460 x MON89034 (stacked with insect resistance), MON87460 x NK603 (glyphosate tolerance) and MON87460 x MON89034 x NK603 (a combination of both). The term 'stacked' applies where two or more GM varieties are combined. This bears a striking resemblance to events in the United States, where Monsanto plans to stack MON87460 as part of a 10-stack GM maize variety.

Biosafety concerns for MON87460

Very little independent biosafety data for MON87460 exists. Monsanto's application to the European Food Safety Authority (EFSA) has been severely criticised by two independent European biosafety organisations, for having omitted important biosafety data on the grounds of commercial confidentiality.[47] EFSA's opinion on MON87460 refers to 'a history of safe use' of the *cspB* protein in food production, but does not show any detailed analysis regarding how the pattern of exposure to humans will not be changed by the introduction of this maize into the food chain.[48]

Monsanto's general release application to the South African biosafety regulatory authority contains a catalogue of bad biosafety practices, including:

The use of bacterially produced surrogate proteins to test for mammalian toxicology. This practice has been called into question by several independent biosafety experts. It is well known that proteins produced within bacteria or a plant can differ in size and expression from each other.[49]

WEMA sensitisation workshop,Kenya.
http://blog.cimmyt.org/wp-content/uploads/sites/11/2013/05/WEMA1.jpg

Animal feeding studies compared MON87460 with non-GM maize varieties with 'genetic backgrounds comparable to MON87460'. In GMO feeding experiments the comparator maize should be the same conventional maize variety minus the GM insert.[50] It is not at all clear from Monsanto's application that this is the case.

Progress is mixed in the remaining four WEMA countries. Field trials of MON87460 commenced in Kenya and Uganda in late 2010, while 'mock field trials', meant to simulate the procedures for a GM field trial but using conventional hybrid varieties, were carried out in Tanzania in 2009 and Mozambique in 2010. WEMA has so far not run GM field trials in Tanzania and Mozambique as the biosafety laws in both countries contain strict liability clauses; the clauses would find the producers of GM technology liable for any damages that may arise from their technology.

As a result, tremendous pressure has been placed on both countries to amend the existing liability clauses in their biosafety legislation. In Tanzania, where WEMA was very active on this front,[51] the biosafety law had been sent to the Attorney General to amend the strict liability to a fault-based liability (basically this shifts liability from the developer to the end user). This was due to be finalised by January 2015 but cabinet changes in the Tanzanian government, including a new Minister of Agriculture, appear to have stalled the process for the time being. In Mozambique the ABNE, another organisation funded by the BMGF, reviewed the liability and redress articles of Mozambique's biosafety law in 2012.[52] In October 2014 Mozambique's Council of Ministers approved a revised biosafety decree and implementing regulations; field trials are expected to commence some time during 2015.[53]

WEMA and MON810

The philanthropic vision of the WEMA project was further clouded in 2011 when it was announced that Monsanto would be 'donating' its insect resistant (Bt) event MON810 to the WEMA project. Bt crops, such as MON810, have been engineered to produce a toxin that targets certain agricultural pests of the *Lepidopteran* family (caterpillars), which is achieved by incorporating a gene isolated from a soil organism called *Bacillus thuringiensis*.[54]

MON810 was first grown in the United States in 1996 and has been grown in South Africa since 1998. In 2010 the patent which Monsanto held on MON810 expired,[55] so this is hardly a case of Monsanto sharing the latest fruits from its enormous R&D streams. However, new stacked GM varieties that contain MON810 will be covered by patent protection. The first field trials for MON810 were carried out in Kenya in 2010, the same year a shipment of 280,000 MT of grain from the same variety was prohibited from being unloaded at Mombasa port due to irregularities in GMO import procedures.[56] In Uganda field trials began in 2013, using seed imported from South Africa.[57]

The overwhelming majority of GM crops worldwide are still HT and Bt varieties, with a growing tendency towards stacked GM varieties containing both traits. In 2014 around 28% of all GM crops planted worldwide were stacked varieties. Even in South Africa there is a growing trend towards stacked GM varieties, with stacked varieties accounting for 54% of the GM maize area in 2013/14.[59]

This is a particularly alarming development given the experiences of South African maize farmers (both large and small-scale) with MON810. MON810 was first grown during the 1998/99 growing season in South Africa and by 2007 the first official reports of insect resistance had been made. By 2010 some regions were experiencing over 50% infestations and, such was the scale of the problem, that Monsanto has withdrawn MON810 from the South African seed market and replaced it with another Bt variety (containing 2 bt genes), MON8903.[60]

The initial reaction of the biotechnology industry in South Africa was to blame the GM maize farmers for not adhering to the 'refugia' planting requirements which, in the case of MON810, required farmers to ensure that 5–20% of their total maize area is planted with non-Bt maize. In a large maize field planted only with Bt maize, target insect pests will be continually exposed to the Bt toxin, and develop resistance which will be passed down to their offspring over a number of generations. Theoretically, planting a non-Bt maize refuge will slow down the evolution of Bt resistance as there will be a reduction in the overall insect population facing Bt exposure. Therefore, resistance will be passed on much slower if pests exposed to Bt breed with pests not exposed to Bt.[61]

However, though farmer compliance with refugia was initially low, assumptions around the expression of Bt in MON810 (essentially the 'dose' of Bt in each maize plant) and the nature for resistance development itself, were equally significant. In 2011 the South African National Biodiversity Institute (SANBI), together with the Norwegian government, published the results of the first independent study into MON810 (or any GM crop) to take place in South Africa. The study found that expression levels of Cry1Ab (the protein in MON810 that is toxic to target pests) varied in different parts of the plant (e.g. between the stem and the cob). So in effect, any insect feeding on a part of the plant with a lower dose would be getting 'vaccinated' against the Cry1Ab toxin.[62]

The study also found that cross-pollination of Bt maize with non-Bt maize would produce low-dose expressing plants, again contributing to resistance. This is of particular significance to small-scale farmers who cultivate maize on plots generally no larger than 10 ha (and on average much smaller), as gene flow in maize can be anything up to 400 m. Therefore a farmer planting Bt maize in this scenario could be the inadvertent cause of gene flow into many neighbouring farms.

Recent studies from the Eastern Cape province of South Africa, where Bt maize has been provided (largely through government sponsored interventions) to smallholders have found evidence of such gene flow between Bt maize and local varieties.[63] Further, many recipients of Bt maize in these areas were not given adequate information about the seeds they had been given, including information about the importance of refuge requirements.[64] However, as stated above, it is debatable whether these refuge requirements are at all feasible in a farming landscape that encompasses many small farms in close proximity to one another.

The study's authors concluded that: 'Current Bt maize varieties in South Africa are expensive, are not suited to planting in

sub-optimal agricultural environments and come with regulations that smallholders do not understand or with which they do not agree. While some of these problems can be remedied, cheaper alternatives are available that are more attuned both to the agro-ecologies of smallholders and to their farming practices.'[65]

Yet more questions have arisen from a recent study comparing expression levels of MON810 with actual Bt content under different environmental conditions. The study found that yellow Bt maize contained up to 40% more Bt protein than the white Bt maize tested; expression of the transgene was reduced under hot/dry conditions compared with cold and wet or 'optimal' conditions in Bt white maize; and the correlation between transgene expression and Bt content was 'disrupted under stressful conditions'. In conclusion, the study noted that 'our findings challenge the general assumption that transgenes in commercially approved genetically modified plants are almost invariably expressed at high levels in all plant tissues and phonological phases'.[66]

The inclusion of MON810, with all its well-documented flaws, within the WEMA project shows a breath-taking level of expediency from Monsanto and confirms those voices within civil society that have described climate-smart agriculture and its ilk as an exercise in corporate green-washing.

The African Agricultural Technology Foundation (AATF)

The AATF is a non-profit organisation based in Nairobi and registered as a charity in England and Wales. Its aim is to facilitate the adoption of GM crops and other methodologies by small-holder farmers in SSA, primarily through the negotiation of licensing agreements with the private sector.

The AATF's original funding was provided by the Rockefeller Foundation, DfID and USAID. It has also received financial support from the BMGF, the Howard G. Buffet Foundation, the Syngenta Foundation and (previously) PepsiCo.[67]

An organisation with significant influence on the agricultural development agenda, the AATF has signed Memoranda of Understanding with the African Union Commission (AUC) in 2010[68] and the African Seed Trade Association (AFSTA) in 2012.[69] In September 2010 the AATF was granted the status of a permanent international NGO observer at the World Intellectual Property Office (WIPO).[70]

In addition to its work with Monsanto on the WEMA project, the AATF is also working with: BASF (*Striga* control in maize); The Syngenta Foundation (to develop a seed technology licensing model); Monsanto (Pod borer resistant cowpea); and Arcardia Biosciences (Nitrogen and Water Efficient Salt Tolerant Rice).[71]

GM drought tolerant maize: an expensive folly?

From the outset the WEMA project has been presented by the biotechnology industry as evidence of the almost limitless possibilities for genetic engineering in agriculture. Indeed, expected yield increases of anywhere up to 35% were regularly quoted, and still are in certain quarters (for example, the ISAAA's latest annual review of GM crops).[72] The figures publically quoted are in stark contrast to the expected yield gains quoted in Monsanto's commercial release applications to the USDA and the South African biosafety regulators. These applications predicted a much more sober 6% reduction in yield loss under water limited conditions, which converts to an approximate yield gain of 1% across the entire US maize belt, with the USDA concluding that under conditions of extreme drought MON87460 is 'unlikely to have any benefit'.[73]

At least civil society and other interested parties are able to glean information on the likely efficacy of MON87460 in the United States. In South Africa, as illustrated above, the WEMA project has been shrouded in secrecy since the first field trials were initiated in 2007. The non-cbi version of Monsanto's general release application for MON87460 cites only the data acquired from field trials in Chile and

Pioneer Hi-Bred hybrid maize seed production, USA.
http://www2.dupont.com/Media_Center/en_US/assets/images/releases/nr_Pioneero81109_Utica_IL_0009.jpg

the United States, obtained over two seasons. Further requests from the ACB for information relevant to South African field trials for WEMA were rejected on grounds of confidentiality.

The fact that only one GM drought-tolerant crop variety has been released in the United States, despite the more than 550 field trials between 1998 and 2011, attests to the complexity of breeding for drought tolerance.[74] In 2008 a US$ 350,000 project funded by USAID also sought to develop GM drought-tolerant maize varieties, adapted to East Africa, using maize germplasm from breeding programmes in Ethiopia, Kenya, Sudan and Tanzania, as well as CIMMYT.[75] However, despite predictions of a commercial release by 2017/18[76] no records of any field trials related to this project can be found at the Kenyan Biosafety Clearing House,[77] while no GMO field trials of any description have yet taken place in Tanzania or Ethiopia.[78]

What is clear is that the WEMA project is being used as justification, however misplaced this may be, to weaken biosafety regulation across the continent, a process in which another BMGF grantee, the ABNE, is also a significant player. It is also facilitating the release of Monsanto's highly compromised (and old) GM insect resistant maize variety, MON810; a variety which has been found to be completely unsuitable for small-scale farming systems, and which is failing even in the large-scale, highly mechanised farming systems for which it was originally intended. Recent research has also questioned assumptions about the efficacy of MON810 under conditions of environmental stress, exactly the conditions to which MON810 will be exposed if it is incorporated into WEMA's maize varieties.

WEMA's conventional hybrid maize activities

Running parallel to WEMA's efforts to produce GM drought-tolerant maize varieties is what has been described, arguably, as Africa's largest maize breeding pipeline. For example, in 2013 WEMA had 22,051 germplasm lines 'under field testing'; 111 trials for conventional drought-tolerant varieties in the WEMA countries; and 44 varieties going through national certification and registration procedures.[79]

One of the central goals of the WEMA project, aside from facilitating the acceptance and release of GM crops on the African continent, has been to encourage the adoption of hybrid maize seed among small-scale farmers in Africa and catalyse the growth of private seed

companies as conduits for the dissemination of WEMA varieties.

WEMA aims to achieve the release of 25 drought-tolerant hybrid maize varieties by 2017 (there is no breeding activity for OPV varieties of maize). According to Dr Gospel Omanya at the AATF, this target has already been passed, with 36 hybrid varieties already released. The most progress appears to have been made in Kenya, where the first WEMA hybrid variety (WE1101) was officially released in June 2013,[80] which was subsequently harvested in January 2014.[81] However, varieties have also been released in Tanzania, Uganda and South Africa (though in South Africa one of the companies selected to market these hybrids, Seed Co, has reported issues with seed supply, and is now hoping to get seed in time to establish demonstration plots for the 2015/16 maize season).[82] No varieties have been released yet in Mozambique though it is possible that this will happen during 2015.[83]

The seed production chain begins with small quantities of 'breeder seed' of high varietal purity, produced by a seed breeder, usually an employee of a private company or a public research institution.[84] In SSA breeder seed typically comes from the latter, either from the NARS or one of the CGIAR centres. Breeder seed is then multiplied under controlled conditions, again usually by the breeder, to produce pre-basic seed. Under the WEMA project, the quality and multiplication of breeder seed is the responsibility of the original breeder in the project, whether it be Monsanto, CIMMYT or one of the NARS; this is true also, in the majority of cases, for the production of pre-basic seed.[85]

This pre-basic seed is then multiplied into basic seed, usually by breeders or private companies. In some countries in SSA where hybrid maize adoption is relatively high, such as Zambia, it is usual for private seed companies to execute this stage. Finally, this basic seed is used to produce certified seed (seed ready to sell). This is achieved either on land under the direct ownership and control of the seed company or, as large plots of land are required for this, seed is supplied on credit to contracted out-growers and re-purchased upon harvest, ready for final processing, distribution and sale.[86]

During 2013 and 2014 Monsanto and CIMMYT were tasked with the production of both basic and certified seed for the WEMA project, owing to concerns about the capacity of private seed companies to produce seed that met the required standard.[87] It was hoped that by 2015 WEMA's partner seed companies would have taken over this responsibility, though capacity shortages have resulted in the AATF also conducting some seed production, as a temporary measure.[88] Some WEMA partner companies, such as Dryland Seed in Kenya, are producing basic and certified seed for sale.[89] Seed companies that produce certified seed are responsible for the registration of that variety via the national seed registration channels of that particular country.[90]

Private seed companies who wish to become involved in the WEMA project need to apply for one of three major licensing agreements: an inbred license, a conventional hybrid license and a transgenic (or GMO) license. These licenses will be given on an exclusive or non-exclusive basis. Companies receiving an exclusive license are expected to reach a minimum sales target after the third year of the release of that hybrid variety and will also be granted first opportunity to market the variety's GM version.[91] Though only five WEMA varieties have so far been licensed from the AATF on an exclusive basis,[92] WEMA's ultimate goal is 'an exclusive licensing environment'.

With an inbred license, a company can sub-license individual inbred lines from the AATF to cross with one of its own inbred lines, to produce its own varieties of hybrid seed. The company can then register these new varieties in their respective countries provided they meet the standard regulatory requirements of that country.[93] Conventional hybrid licenses are sub-divided into licenses for the production of seed only, distribution only, or a combination of both. Licensing agreements for GM maize varieties are sub-divided along the same lines as those for conventional hybrids.[94]

To date, most of the seed companies that have received licenses to produce and/or distribute WEMA hybrids are small to medium sized nationally based seed companies, a notable exception being the involvement of Zimbabwean based Seed Co (though in South

WEMA hybrid maize variety, Kenya.
http://thedailymail.co.ke/wp-content/uploads/2015/01/Tego.jpg

Africa Seed Co is very much in the shadow of Monsanto and Pioneer Hi-Bred, who dominate the maize seed industry). However, many of these companies are seen as the next generation of large African seed companies, having received financial support from a variety of funding sources that can ultimately be traced back to the BMGF, including AGRA, the African Seed Investment Fund (ASIF) and the African Enterprise Challenge Fund (AECF). Many of these companies are also involved in marketing varieties that have been produced by the DTMA project.

In Kenya, where the first WEMA 'DroughTego' hybrid varieties were released in June 2013, eight seed companies are currently involved in seed marketing and/or production. Of these, Dryland Seed, which has been marketing for two years, had previously received grant funding from AGRA's Programme for Africa's Seed Systems (PASS) and investment funding from the AECF[95] and the ASIF.[96] Dryland also markets maize varieties produced by the DTMA project. Another Kenyan seed company, Freshco[97] is also a DTMA partner company and in 2013 it received a US$ 600,000 investment, in the form of a quasi-equity loan, from the ASIF.[98] Another AGRA grantee involved in the WEMA project in Kenya is Leldet Seed. A similar pattern emerges in Tanzania, where AGRA has previously supported three WEMA partner seed companies (Meru Agro, IFFA Seeds and Suba Agro) and Uganda, where the ASIF has invested in two of the companies involved.[99]

The African Seed Investment Fund (ASIF)

The ASIF was launched in 2009 with a US$ 12 million grant from AGRA to invest in at least 20 small to medium size seed companies in eastern and southern Africa. ASIF is managed by Pearl Capital Partners, an agricultural investment management fund based in Kampala, Uganda, though domiciled in Mauritius.[100] ASIF's investments are typically in the form of loans, and conversions into equity stakes in such companies are not uncommon.[101]

The African Enterprise Challenge Fund (AECF)

The AECF is a US$ 207 million fund that awards grants and loans to 'stimulate private sector entrepreneurs in Africa' and operates in agriculture, agribusiness, renewable energy, adaptation to climate change and access to information and financial services. Its major donors are DfID (US$ 99 million), SIDA (US$ 39 million), the Australian Department of Foreign Affairs and Trade (US$ 32 million), the Royal Netherlands Embassy (US$ 25 million and DANIDA (US$ 12 million). The board of AGRA has 'ultimate fiduciary responsibility and accountability for AECF'.[102]

According to its website, 53% of AECF's investments have gone into agribusiness. Small-companies (classified as having less than US$ 1 million in annual turn-over) have accounted for 60% of investments to date, with a third of funding going to companies whose annual turn-over ranges from US$ 1 million to US$ 10 million, the remainder being with companies with an annual turn-over of more than US$ 10 million.[103]

WEMA's hybrid maize breeding programme represents classic Green Revolution thinking. Though GM traits and germplasm have been donated royalty free to the project, WEMA hybrid varieties are being sold at standard commercial rates. This is in line with WEMA's goals to kick-start a commercial hybrid maize seed industry in its countries of operation and not to 'undermine existing seed development and market activity with unfair competition'.[104] WEMA also recommends the use of synthetic fertilisers (along with other good agricultural practices) with its hybrid varieties,[105] which are generally even more costly than the price of seed. The adoption of these expensive inputs will currently be impossible for all but a small minority of farmers; for the majority, adoption will only be possible with access to either public subsidies or some form of debt finance, both of which have long-term implications for social relations and differentiation in rural SSA.

Aside from issues around price, WEMA's dissemination model, relying as it does on the proliferation of certified seed, is concerning for other reasons. Even in a crop such as maize, for which a commercial market for seed already exists in many countries in SSA, the majority of maize is planted with re-saved seed, often from local varieties or OPV's that have come from the NARS. In Mozambique and Tanzania just 7% and 27% of the maize crop respectively was planted using certified seed during the 2010/11 season.[106]

In addition, hybrid maize seed varieties cannot be replanted in the following season without significant yield loss because, unlike OPV, replanted hybrid seed does not reproduce the characteristics of its parent lines. Thus, to achieve optimum potential yield a farmer must re-purchase fresh hybrid seed every year from the company that produces it. In rural SSA for a variety of reasons, not least the cost, this is not feasible for the majority of farmers without entering into debt or selling other important assets (animals, for example). Hybrid seed therefore gives farmers far less flexibility in their farming decisions than would local varieties or OPVs.[107]

There is currently a raft of policy and legal changes on the table concerning both intellectual property rights over seeds and laws regarding what kind of seeds can be legally traded. In essence, the aim of these laws is to encourage private investment in agricultural research through strengthening intellectual property rights over seed, including potential restrictions on the rights of farmers to save and re-plant seed.[108]

Proposed changes to seed trade laws are potentially able to exclude all varieties that cannot fulfil the DUS requirements for being traded legally. DUS requires a variety to be 'distinct', 'uniform' and 'stable', but the distinctness of a variety is more important to those who benefit from ownership than farmers, while uniformity actually runs counter to the importance of contextual diversity which is a key factor, particularly given the vagaries of climate which many farmers now face.[109] Even the World Bank has called some of these proposed new laws too onerous and potentially

damaging to existing trade in local varieties and landraces[110] within SSA.[111]

The central role of the private sector in the WEMA project echoes that of the wider green revolution push. While none of the companies currently involved in marketing WEMA hybrids could be described as multinationals (with the possible exception of Seed Co), a number of them have received investments from a variety of agri-business investment vehicles that are supported in some way by the BMGF.

The sums being invested, parts of which take on the form of loans, reflect the huge costs and technical requirements of hybrid seed production. A recent study commissioned by the BMGF into 'early generation seed production' in Africa gave an example from Zambia, where the production of 1,000 MT of certified hybrid maize seed would cost nearly US$ 2.5 million. The study concluded that for a seed company to carry out fully integrated seed production (from breeder seed to certified), and remain profitable, seed prices would have to remain above US$ 3.50 per kg.[112]

Given this environment, how long will it be before these African seed companies themselves are targeted by the large multinational corporations, many of which already have a commercial presence on the continent? The consolidation of the global seed industry, and the control by Monsanto, Pioneer Hi-Bred and Syngenta of over 50% of the global commercial seed market, is well documented.[113] In South Africa, which has the most commercially developed seed market in SSA, the situation is even more pronounced, with Monsanto and Pioneer-Hi Bred controlling the maize seed industry. Both companies obtained these dominant market positions by acquisition: Monsanto acquired Carnia and Sensako, two of South Africa's largest seed companies at the time, over the course of 1999 and 2000. In 2012 Pioneer Hi-Bred acquired South Africa's largest remaining seed company, Pannar Seed, a company with a significant presence in several countries in SSA. Limagrain, Europe's largest seed company, has recently made a significant investment in Seed Co, a Zimbabwean seed company with a large African footprint.[114]

WEMA, Intellectual Property (IP) and access to genetic resources

It is generally recognised that the most important factor in plant breeding is the choice of breeding populations chosen for improvement,[115] a principle that applies both to conventional breeding and plants produced from genetic modification. In the WEMA project these breeding populations consist of 'elite maize germplasm lines' donated by each partner (Monsanto, CIMMYT and the NARS of the five WEMA countries). WEMA's IP policy does not stipulate how many elite maize germplasm lines each party is expected to donate.

In accordance with WEMA's IP policy, each party maintains ownership of all the IP it contributes to the WEMA project (whether that be maize germplasm or other breeding technologies). This ownership is to be determined by US law on 'inventorship'. Each party also maintains the right to maintain their own parallel breeding programmes within the WEMA project and to take IP protection on any new discoveries made by their own breeders, regardless of the source of the germplasm used to develop these.[116]

Monsanto has made much currency from the donation of its elite germplasm lines to the WEMA project, but in exchange it is also gaining access to a treasure trove of maize germplasm within the NARS of the five WEMA countries and CIMMYT. Maize breeding at CIMMYT can be traced back to the 1940s, when the Rockefeller Foundation initiated breeding programmes for maize and wheat in Mexico. CIMMYT has been selecting for drought tolerance since 1975,[117] and in 1997 it initiated a dedicated programme for breeding drought-tolerant maize for southern Africa.[118] These efforts were significantly scaled-up in 2007 through the establishment of the DTMA. Much of the maize germplasm that CIMMYT has provided to the WEMA project has come from research conducted by the DTMA and earlier projects.

Accessing genetic resources for agricultural research, particularly those coming from the public sector, is a complex process. Generally, private companies such as Monsanto engage in complex (and confidential) licensing

Part of CIMMYT's maize working collection, containing hundreds of thousands of envelopes with seed of all the lines in active use in breeding and pre-breeding, including those planted in every trial grown over the last five years.
https://www.flickr.com/photos/cimmyt/5227279211/in/set-72157624341907784

agreements with one another. However, in public-private partnerships such as WEMA, which involve public resources, international instruments have been established to regulate such transfers. The most significant of these in terms of agriculture is the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), while the Nagoya Protocol on Access and Benefit Sharing (ABS) of the United Nations Convention on Biodiversity (UNCBD), depending on the circumstances, could also come into play.

The ITPGRFA came into force in 2003 and, following agreements signed between it and CGIAR, all the genetic resources within CGIAR were brought within the purview of the ITPGRFA. As CIMMYT is part of CGIAR, this applies equally to all of CIMMYT's genetic resources including its maize germplasm. CIMMYT provides all its materials to the WEMA project through a standard material transfer agreement (SMTA) and retains the rights over these materials for the purposes of research, breeding and training.[119]

Unfortunately, to all but those well versed in the intricacies of the ITPGRFA, or directly involved in the WEMA project, it is extremely difficult to get a clear picture of who derives the most benefit from these agreements. In 2013 the ACB lodged a Promotion of Access to Information Act (PAIA) request to the South African Agricultural Research Council (ARC) regarding the nature of the agreements it had signed with the WEMA project, but our request was denied on grounds of confidentiality.[120] Similarly, a recent PAIA request to Monsanto, for information on the varieties and pedigree of the hybrid maize being used in field trials for its GM maize MON87460 in South Africa, was also rebuffed.

The Drought Tolerant Maize for Africa (DTMA) project

The DTMA was launched in 2007 with more than US$ 40 million in funding from the BMGF, with smaller amounts provided also by the Howard G. Buffet Foundation and the UK government's DfID. The CIMMYT and the International Institute for Tropical Agriculture (IITA) are the main implementing partners, together with the NARS in each of the DTMA's 13 countries.[121] The DTMA's advisory board includes representatives from the Alliance for a Green Revolution in Africa (AGRA), Pioneer Hi-Bred and Seed Co.

The DTMA project does not include any genetic engineering but does employ other modern-breeding technologies, such as marker-assisted recurrent selection (MARS) and genomic selection. These are both technologies that can significantly speed up the conventional breeding process. As at December 2014 the DTMA project had developed a total of 160 varieties incorporating increased drought tolerance, in addition to other traits, such as resistance to major diseases. Of the 160 varieties, 94 are hybrid and 66 are OPVs.[122]

The DTMA website lists close to 90 seed companies, farmer groups or parastatal organisations that stock DTMA derived

varieties for sale, most of whom are small and medium size national companies. As with the WEMA project, seed companies are provided with basic seed to multiply. Unlike the WEMA project however, there are no sub-licensing agreements under DTMA;[123] companies are provided with DTMA seed free of charge from either CIMMYT (if they are based in eastern or southern Africa) or the IITA (in west Africa), though they must cover transport costs. Some companies that have sourced DTMA varieties through their national agricultural research institutions have reported having to pay for seed.[124]

As with the WEMA project, there appears to be a high degree of co-ordination with AGRA; at least 18 DTMA seed companies had previously received AGRA grants, while a joint working group has been established between DTMA and AGRA's PASS programme, though at the time of writing this is still in its infancy.[125]

In November 2014 the next phase of the DTMA project was launched in Addis Ababa, Ethiopia, titled 'Drought-tolerant Maize for Africa Seed Scaling' (DTMASS). DTMASS, funded by USAID, is being implemented in seven countries in eastern and southern Africa: Ethiopia, Kenya, Malawi, Mozambique, Tanzania, Uganda and Zambia. Its purpose is to 'scale up' access to the original drought-tolerant varieties bred in the earlier phases of the DTMA project, with a target of 12,000 MT of certified seed to be produced by 2019. According to the DTMA project leader, Dr Tsedeke Abate, DTMASS will have a greater emphasis on the marketing of existing varieties and, as such, no new research will be conducted. In addition to the seed companies with which the DTMA has already established working relationships, new entrants to the seed industry will also be involved. So far, South African seed company Klein Karoo and Zimbabwe based Seed Co are the only major regional seed companies involved in the DTMASS.[126]

Conclusion

If we do persist with business as usual, the world's people cannot be fed over the next half-century. It will mean more environmental degradation, and the gap between the haves and have-nots will expand. We have an opportunity now to marshal our intellectual resources to avoid that sort of future. Otherwise we face a world nobody would want to inhabit.
Professor Robert T. Watson, Director of the IAASTD[127]

Sub-Saharan Africa is expected to bear the brunt of the impacts of climate change over the coming century. Its agricultural systems, particularly maize-based cropping systems, will be particularly hard hit. There is no doubt that action is needed, but it is also clear that we have reached a fork in the road with our current agricultural system. One of the options is essentially more of the same—an updated green revolution model that relies on expensive and ecologically harmful inputs, GM crops and the ever increasing commodification of social and ecological relations.

Many of these methodologies have been gathered under the umbrella term of Climate Smart Agriculture (CSA), first developed by the UNFAO but since carried forward by northern governments, the World Bank and multinational agribusiness corporations. Though pilloried by much of civil society, CSA has gained a lot of traction in international policy debates and is given an aura of legitimacy by the active participation of CGIAR's programme on climate change in its structures. The choice of the WEMA project as a flagship CSA project is a worrying indication of how much ground has been lost in the climate change debate.

Much has been made of the potential for GM to deliver climate resilient crops but the reality beyond the rhetoric is that after more than 17 years of field trials in the United States, only one GM drought-tolerant maize variety has been released. Independent analysis has shown that, under moderate drought conditions, this variety will at best increase maize productivity in the United States by 1% annually, which is equivalent to improvements gained in conventional maize breeding. However, Monsanto and the rest of the biotechnology

industry are using this largely unproven technology to weaken biosafety legislation on the continent and expose Africa to GM crops generally. The inclusion of Monsanto's insect resistant GM maize variety MON810 in the WEMA project is indicative of this.

WEMA is also dovetailing with efforts already underway on the continent to build a private seed industry and spread the adoption of hybrid maize varieties. This is problematic for a number of reasons. Hybrids have to be re-purchased every-year and this immediately gives the farmer less flexibility regarding his or her farming decisions—something that will be essential in this era of uncertain climate. Also, hybrid seeds generally cannot reach their full yield potential without the addition of other inputs, such as fertilisers, the use of which is being recommended by WEMA. The emergence of a commercial seed industry in SSA is likely to lead to high levels of concentration over time, as has happened at the global level. Many of the world's largest seed companies, such as Monsanto, Pioneer Hi-Bred, Limagrain and Syngenta, are already active on the continent.

Already in much of SSA private seed companies focus almost exclusively on potentially lucrative seed markets, such as hybrid maize, to the detriment of other crops that may be more suitable under harsh climatic constraints. Maize, of all the food crops, is undoubtedly the major focus of research efforts in SSA. As stated above, hybrid maize breeding and marketing has a long history in SSA and is driven largely by power relations and institutional interests.

The DTMA project has released over 160 maize varieties since its inception (at least 94 of which are hybrid), while AGRA's PASS had released 118 maize varieties by the end of 2014. In comparison, 28 varieties of sorghum and just 13 varieties of millet had been released.[128] Maize also features strongly under the G8 New Alliance for Food Security and Nutrition, and Pioneer Hi-Bred, Monsanto and Syngenta have all pledged to work on increasing hybrid maize adoption in G8 countries, while fertiliser giant Yara is also working on maize value chains in Tanzania.[129]

This wave of investment is being underwritten by dramatic changes in the policy and legal environment, ostensibly to stimulate further private investment. However, these changes threaten to exclude the vast majority of small-scale farmers in SSA from any meaningful participation in agricultural R&D, and to shift attention away from the continent's vast agricultural biodiversity towards a few commercially lucrative and tradable crops. This system is firmly embedded in South Africa which is seen as a beacon of agricultural innovation and productivity on the continent. However, though South Africa produces regular maize surpluses, 1 in 4 people go to bed hungry and high levels of diet-related non-communicable disease wrack the country.[130]

Therefore, instead of throwing such vast sums at WEMA and similar projects, we call on the BMGF and the rest of the donor community to:

- Undertake long-term monitoring of the socio-economic and environmental impacts of the adoption of WEMA hybrid (and later GM) maize varieties;
- Prohibit any further funding for GM crop research in Africa;
- Shift focus from hybrid to OPV in maize breeding and development and explore ways for greater interaction between farmer managed seed systems and the research sector concerning OPVs generally;
- Increase funding for more public-sector-led research into grain crops that are more adapted to drier climates, such as sorghum and millet;
- Increase funding and support into agro-ecological production methods;
- Support the development and application of participatory plant breeding methodologies between small-scale farmers and public sector researchers and scientists;
- Support the development of alternative, more transparent, plant proprietary ownership mechanisms on the continent;
- Support the development of alternative seed quality criteria with farmers and other public institutions that offer flexibility and encourage crop diversity; and
- On matters pertaining to access to genetic resources for agriculture under the ITPGRFA and the Nagoya Protocol the ACB welcomes contributions from experts in this field towards making the multilateral system more transparent.

Annexure 1: The Consultative Group on International Agricultural Research (CGIAR)

While formally established in 1971, CGIAR's roots can be traced back to the Rockefeller Foundation's Mexican Agriculture Programme, which was set up in 1943. Looking to expand on this Green Revolution conducted in Mexico, the Rockefeller Foundation went into partnership with the Ford Foundation to create the International Rice Research Institute (IRRI) in the Philippines in 1960. The international approach taken by IRRI was adopted by the original wheat programme in Mexico, resulting in its re-organisation in 1966 into the International Maize and Wheat Improvement Centre, (known by its Spanish abbreviation of CIMMYT).[131]

The Rockefeller and Ford Foundations established two additional international centres in 1967: the International Institute of Tropical Agriculture (IITA) in Nigeria and the International Centre for Tropical Agriculture (CIAT) in Columbia. Very soon the financial needs of the four centres began to exceed the funding capacity of the two foundations. Following meetings between the two foundations, the World Bank, the UNFAO and the United Nations Development Programme (UNDP), CGIAR was formally established in 1971. By the end of the decade a further nine new centres had joined CGIAR and the number of donors had increased from 17 to 29, increasing investment in the CGIAR centres from US$ 21 million to US$ 141 million over the same period. However, by the early 1990s, as other development issues gained priority, CGIAR was facing significant funding shortfalls.[132]

The turn of the century marked a period of transition within the CGIAR centres, with more emphasis on multi-disciplinary, multi-centre research programmes. This led to corresponding changes in project funding, monitoring and evaluation and governance issues. This culminated in the official launch of the 'New CGIAR' in 2010. Essentially, CGIAR's 15 centres were merged under one operational entity, intended to oversee 15 CGIAR global research programmes[i] and the creation of a separate CGIAR fund, to be housed at the World Bank in Washington, D.C. During this period of restructuring the BMGF officially joined CGIAR[133] and currently sits on the CGIAR Fund Council.[134]

The restructuring of CGIAR has coincided with a re-emphasis on agriculture in the wake of the food price spikes of 2007–2008, and the discourse around global demographic changes and climate change. Consequently, CGIAR has seen its funding increase from US$ 531 million in 2008 to US$ 986 million in 2013 and the BMGF has now become one of CGIAR's largest donors; the US$ 82 million it contributed in 2013 was bettered only by the US$ 114 million contribution from the USA, and is more than double the contribution from next largest donor (Australia, at $36 million). Between 2010 and 2013 the BMGF gave US$ 295 million to CGIAR.[135]

CGIAR and genetic resources

In the years since it was first established CGIAR has amassed one of the world's largest *ex situ*[136] collections of genetic resources for agriculture, with some 710,000 accessions of cereals, legumes, roots, tubers, trees and other crops in its various gene banks.[137] In 1994 the UNFAO and 11 CGIAR centres signed agreements that placed their collections of plant germplasm under the auspices of the UNFAO, to be held 'in trust for the benefit of the international community, in particular developing the developing countries in accordance with the international undertaking on plant genetic resources'.

i. The CGIAR global programmes focus on: gene banks; dry land cereals; grain legumes; livestock and fish; maize, rice; roots, tubers and bananas; wheat; aquatic agricultural systems; dry land systems; integrated systems for the human tropics; water, land and ecosystems; climate change, agriculture and food security; forests, trees and agro-forestry; agriculture and nutrition for health; and policies and institutions and markets.

In 1996 the CGIAR centres, recognising 'a rapidly changing intellectual property rights environment, the issue of farmer's rights and the growing importance of the private sector', published its guiding principles on intellectual property and genetic resources. Broadly speaking, the guiding principles re-iterated that CGIAR germplasm is held in trust and that the centres should provide 'ready access' to applicants. The principles also recognised the sovereign rights of states over their genetic resources and re-affirmed their support for the development of policies related to farmers' rights. The principles also saw CGIAR broach the delicate issue of intellectual property on genetic resources, patents and licensing agreements. Generally, the principles favour access that is as open as possible, but there are caveats; for example, it is accepted that private breeders can protect the products of their breeding (that have drawn upon CGIAR materials) as long as others are not precluded from using the original CGIAR germplasm.[138]

With the advent of the ITPGRFA in 2003, agreements were signed between it and CGIAR which in 2006 placed the CGIAR collections within the purview of the ITPGRFA. One of the conditions of these contracts stipulates that, since 1 January 2007, all germplasm transferred from the CGIAR centres to third parties must be accompanied by an SMTA.[139]

Reflecting the new structure of the CGIAR system and the evolving IP landscape in agricultural research, in March 2012 CGIAR published new 'Principles on the Management of Intellectual Assets'. While the overall vision remains unchanged the new principles provide much more detail than was previously specified. For example, they permit the use of limited exclusivity agreements and restricted use agreements with third parties, under certain conditions.[140] In addition, the principles call on the centres to provide the capacity (and funding) to manage their intellectual assets and also require each centre to submit annual reports on their activities concerning intellectual assets.[141]

Annexure 2: WEMA's project goals

a) Establish capacity in selected African countries to enable technical work, including materials, people and plans for analysis, backcrossing, mapping, breeding and field-testing.
b) Conduct molecular analysis of existing CIMMYT maize lines entering the breeding program in sub-Saharan Africa to enable objectives c and d.
c) Improve CIMMYT lines by incorporating relevant Quantitative trait loci (QTLs) using state-of-the-art marker-assisted breeding systems.
d) Conduct marker-assisted breeding using Monsanto's proprietary marker and bioinformatics systems to improve CIMMYT drought-tolerant germplasm and to identify QTLs in CIMMYT drought-tolerant germplasm.
e) Develop tropical hybrids containing drought tolerance genes for testing in selected African countries.
f) Develop Standard Operating Procedures (SOPs) and conduct rigorous field tests in compliance with all regulations in the selected countries.
g) Develop and implement strategies to secure regulatory approval for safe confined field trials on the basis of professional applications in the selected countries.
h) Establish a Communication Strategy and Plan to cover all phases of the project in the selected countries.
i) Improve understanding and develop positive working relations with national governments, partners and other stakeholders in the selected countries.
j) Ensure that the developed drought-tolerant maize products will be accessible to smallholder African farmers.
k) Ensure effective management of the project.

Annexure 3: GMO permits for MON87460 granted in South Africa

2014

Organism	Trait	Foreign supplier/ receiver	Quantity	Purpose
MON87460	Drought Tolerance (DT)	Kenya	15 g	Export for confined field trial
MON87460	DT	USA	130 kg	Import for trial release
MON87460	DT	USA		Trial release
MON87460	DT	USA		Trial release
MON87460	DT	USA		Trial release
MON87460	DT	Uganda	15.4 kg	Export for confined field trials
MON87460 x MON89034	DT x Insect resistance (IR)	USA	133 kg	Import for trial release
MON87460 x MON89034	DT x IR	USA	133 kg	Trial release
MON87460 x MON89034 x NK603	DT x IR x Herbicide Tolerance (HT)	USA	200 kg	Import for trial release
MON87460 x MON89034 x NK603	DT x IR x HT	USA	200 kg	Trial release
MON87460 x NK603	DT x HT	USA	190 kg	Import for trial release
MON87460 x NK603	DT x HT	USA	190 kg	Trial release
MON87460 x MON810	DT x IR	USA	90 kg	Import for trial release
MON87460 x MON810	DT x IT	USA	90 kg	Trial release

2013

Organism	Trait	Foreign supplier/ receiver	Quantity	Purpose
MON87460	DT	USA	240 kg	Import for trial release
MON87460	DT	USA	240 kg	Trial release
MON87460	DT	USA	240 kg	Trial release
MON87460	DT	USA	240 kg	Trial release
MON87460	DT	Kenya	15 kg	Export for trial release
MON87460	DT	Chile	1 kg	Export for trial release

Annexure 4: Bill and Melinda Gates Foundation grants to WEMA and related projects

Grantee	Purpose	Grant (US million $)	Term	Grantee location
AGRA	Establish PASS programme	96.9	December 2006 (61 months)	Nairobi, Kenya
CIMMYT	DTMA	5.8	December 2006–Nov 2007	Texcoco, Edo. Mexico
CIMMYT	DTMA	33.3	Nov 2007–Dec 2012	Texcoco, Edo. Mexico
Michigan State University	Establish ABNE	1.5	November 2007 (31)	Michigan, United States
AATF	WEMA	35.9	Feb 2008–Feb 2013	Nairobi, Kenya
Michigan State University / NEPAD	ABNE	10.4	October 2009 (60)	
Pearl Capital Partners (fund manager)	African Agricultural Investment Fund	17	Sep 2011 (equity investment)	Uganda
CIMMYT	DTMA	33.7	October 2011 (51)	Texcoco, Edo. Mexico
AGRA	PASS	56	November 2011 (62)	Nairobi, Kenya
AATF	WEMA	48.9	October 2012 (64)	Nairobi, Kenya
AGRA	Develop state of the art breeding pipelines	12.3	October 2013 (49)	Nairobi, Kenya
Michigan State University	Biosafety regulatory systems in Africa	12.2	August 2014 (65)	Michigan, United States

References

1 International Panel on Climate Change. **IPCC 5th Assessment report.** https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/drafts/fd/WGIIAR5-Chap22_FGDall.pdf; (accessed 20/04/2015).

2 Cairns, J.E., Hellin, J., Sonder, K., Araus, J.L., MacRobert, J.F., Thierfelder, C. and Prasanna, B.M. 2013. **Adapting maize production to climate change in Sub-Saharan Africa.** Food Sec. 5:345-360. DOI 10.1007/s12571-013-0256-x.

3 Stabinsky, D. 2014. **Climate-Smart Agriculture: myths and problems.** Heinrich-Böll-Stiffung. http://br.boell.org/sites/default/files/uploads/2014/09/epaper_climate_smart_eng_boll_brasil18.09.014.pdf; (accessed 21/04/2015).

4 Neate, P. 2013. **Climate-smart agriculture: Success stories from farming communities around the world.** CGIAR Research Programme on Climate Change.

5 Stabinsky, D. 2014. **Climate-Smart Agriculture: myths and problems.** Heinrich-Böll-Stiffung. http://br.boell.org/sites/default/files/uploads/2014/09/epaper_climate_smart_eng_boll_brasil18.09.014.pdf; (accessed 21/04/2015).

6 AGRA. 2014. **African agricultural status report: Climate change and small-holder agriculture in Sub-Saharan Africa.** Nairobi: Alliance for a Green Revolution in Africa.

7 Nyasimi, M., Amwata, D., Hove, L., Kinyangi, J. and Wamukoya G. 2014. **Evidence of Impact: Climate-Smart Agriculture in Africa.** CCAFS Working Paper No. 86. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. https://cgspace.cgiar.org/bitstream/handle/10568/51374/WP86.pdf; (accessed 22/04/2015).

8 Scoones, I. and Thompson, J. 2011. **The politics of seed in Africa's Green Revolution: Alternative narratives and competing pathways.** IDS Bulletin, volume 42, number 4. Oxford: Institute for Development Studies.

9 Smale, M., Byerlee, D. and Janye, T. 2011. **Maize revolutions in sub-Saharan Africa.** World Bank Policy Research Working Paper 5659. Washington, D.C.: The World Bank.

10 Scoones and Thompson. 2011.

11 Jayne, T.S. and Rashid, S. 2013. **Input subsidy programs in Sub-Saharan Africa: a synthesis of recent evidence. Agricultural economics.** 44(6), 547–562.

12 ACB. 2014. **Running to stand still: small-scale farmers and the Green Revolution in Malawi.** Johannesburg: African Centre for Biosafety.

13 Chinsinga, B. 2011. **Seeds and subsidies: The political economy of input programmes in Malawi.** IDS Bulletin, volume 42, number 4. Oxford: Institute for Development Studies.

14 World Bank. 2012. **Agribusiness indicators: Tanzania.** Washington D.C.: The World Bank.

15 **Acquisition of Africa's Seed Co by Monsanto, Groupe Limagrain: Neo-colonial occupation of Africa's seed systems.** Media advisory by the Alliance for Food Sovereignty in Africa (AFSA). Addis Ababa. 8 October 2014.

16 Viser, J. **Monsanto targets smallholder farmers.** 8th January, 2015. Farmer's Weekly. http://www.farmersweekly.co.za/article.aspx?id=67535&h=Monsanto-targets-smallholder-farmers; (accessed 20/04/2015).

17 ACB. 2014. **The political economy of Africa's burgeoning chemical fertiliser rush.** Johannesburg: African Centre for Biosafety.

18 Agrawala, S., Bordier, C., Schreitter, V. and Karplus, V. 2012. **Adaptation and innovation: An analysis of crop biotechnology patent data.** Environmental Working Paper No. 40. Paris: Organisation of Economic Co-Operation and Development (OECD). http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP(2011)10&docLanguage=En; (accessed 16/04/2015).

19 **Remarks by Administrator Rajiv Shah at the Chicago Council on Global Affairs.** 22 May 2014. http://www.usaid.gov/news-information/speeches/may-22-2014-administrator-rajiv-shah-chicago-council-global-affairs; (accessed 26/03/2015).

20 **African Agricultural Technology Foundation (AATF)—phase 2.** Project record—Department for International Development. http://r4d.dfid.gov.uk/Project/60707/; (accessed 26/03/2015).

21 **How does the Gates Foundation spend its money to feed the world?** Against the Grain, November 2014. http://www.grain.org/article/entries/5064-how-does-the-gates-foundation-spend-its-money-to-feed-the-world; (accessed 19/04/2015).

22 Ibid.

23 Ozediz, S. 2012. **The CGIAR at 40: Institutional evolution of the world's premier agricultural research network.** Washington, D.C.: CGIAR Fund Office.

24 CGIAR Fund Council membership. http://www.cgiar.org/who-we-are/cgiar-fund/fundcouncil/membership/; (accessed 23/03/2015).
25 **Bill and Melinda Gates Foundation Grants database.** http://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database; (last accessed 20/04/2015).
26 AATF. **Combining Breeding and Biotechnology to Develop Water Efficient Maize for Africa (WEMA).** http://www.aatf-africa.org/userfiles/Wema-Concept-Note.pdf; (accessed 19/04/2015).
27 Heinemann, J. 2009. **Hope not hype: The future of agriculture directed by the International Assessment of Agricultural Knowledge, Science and Technology for Development.** Penang, Malaysia: Third World Network.
28 **Application for general release of genetically modified maize containing MON87460 in South Africa.** Application submitted by Monsanto to the Department of Agriculture, Forestry and Fisheries in August 2014. http://www.daff.gov.za/doc/Application%20for%20general%20release%20of%20genetically%20modified%20maize%20containing%20MON87460%20in%20South%20Africa.pdf; (accessed 21/01/2015).
29 **BASF plant science and Monsanto to expand their collaboration in maximizing crop yield.** 7 July 2010. http://news.monsanto.com/press-release/basf-plant-science-and-monsanto-expand-their-collaboration-maximizing-crop-yield; (accessed 08/04/2015).
30 Friends of the Earth International. 2015. **Who benefits from GM crops? The expansion of agribusiness interests in Africa through biosafety policy.** Amsterdam: Friends of the Earth.
31 Monsanto Annual reports 2008–2014. Available at: http://www.monsanto.com/investors/pages/annual-report.aspx; (accessed 27/03/2015).
32 **(WO2005033318) METHODS FOR ENHANCING STRESS TOLERANCE IN PLANTS AND METHODS THEREOF** https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2005033318&recNum=3&office=+%28OF%3Awo%29&queryString=PA%3AMonsanto+AND+IN%3AFernandes+&prevFilter=&sortOption=Pub+Date+Desc&maxRec=6; (accessed 10/04/2015).
33 Gurian-Sherman, D. 2012. **High and dry: Why genetic engineering is not solving agriculture's drought problem in a thirsty world.** Cambridge, MA: Union of Concerned Scientists.
34 Ibid.
35 James, Clive. 2014. **Global Status of Commercialized Biotech/GM Crops: 2014.** *ISAAA Brief* No. 49. Ithaca, NY: ISAAA.
36 **Monsanto company's CEO Hugh Grant on Q1 2015 results—earnings call transcript.** 7 January 2015. Seeking Alpha. http://seekingalpha.com/article/2805045-monsanto-companys-mon-ceo-hugh-grant-on-q1-2015-results-earnings-call-transcript?part=single; (accessed 09/04/2015).
37 SANSOR 2014. **Annual report 2013/14.** Pretoria: South African National Seed Organisation.
38 **South African Crop Estimates Committee—final production estimate for 2014.** http://www.sagis.org.za/Flatpages/Oesskattingdekbrief.htm; (accessed 21/04/2015).
39 **WEMA Intellectual Property Policy.** http://www.aatf-africa.org/userfiles/wema-ip-policy.pdf; (accessed 04/02/2015).
40 ACB. 2007. **Monsanto's genetically modified drought-tolerant maize in South Africa.** Johannesburg: African Centre for Biosafety. http://www.acbio.org.za/images/stories/dmdocuments/acb-droughtstressgmmaize2.pdf.
41 ACB. 2010. **ACB's objection to Monsanto's application for trial release of drought-tolerant GM maize MON87460.** Johannesburg: Africa Centre for Biosafety. http://www.acbio.org.za/images/stories/dmdocuments/ACB_Objection_drought_tolerant_maize_April_2010.pdf.
42 ACB. 2012. **Objection to Monsanto's application for an extension permit for field trials of MON87460.** African Centre for Biosafety: Johannesburg. http://www.acbio.org.za/images/stories/dmdocuments/ACB-mon87460_fieldtrial.pdf.
43 Ibid.
44 ACB. 2013. **African bullied to grow defective Bt maize: The failure of Monsanto's MON810 maize in South Africa.** Johannesburg: African Centre for Biosafety.
45 Ibid.
46 Nompumelelo Mkhonza, Registrar: GMO Act. Personal correspondence. 14/01/2015.
47 Myhr, A.I. and Quist, D. 2010. **Impact assessment of maize MON87460 from Monsanto (EFSA.GMO/NL/2009/70).** Genok Centre for Biosafety. http://genok.no/wp-content/uploads/2013/03/genok_raad_apr2010_h70-pdf.pdf; (accessed 03/01/2015).
48 Then, C. and Panskus, B. 2013. **Testbiotech comment on EFSA Scientific Opinion on an application (EFSA-GMO- NL-2009-70) for the placing on the market of genetically modified drought-tolerant maize MON 87460 for food and feed uses, import and processing under Regulation (EC) No 1829/2003 from Monsanto.** http://www.keine-gentechnik.de/fileadmin/files/Infodienst/Dokumente/2013_01_10_Comment_Mon87460_

Testbiotech.pdf; (accessed 10/02/2015).
49 Quist, D. 2011. **Study to characterize the protein structure of the CryIAb transgenic (Bt) protein from MON810 maize and a comparison to the same protein produced in bacteria.** Monitoring the Environmental Impacts of GM maize in South Africa: The Outcomes of the South Africa-Norway Biosafety. Pretoria: Department of Environmental Affairs.
50 Pusztai, A. and Bardocz, S. (2006). **GMO in animal nutrition: potential benefits and risks.** *Biology of Nutrition in Growing Animals,* 513-540.
51 Friends of the Earth International. 2015. **Who benefits from GM crops? The expansion of agribusiness interests in Africa through biosafety policy.** Amsterndam: Friends of the Earth.
52 Esterhuizen, D. and Zacarias, A. 2013. **Agricultural biotechnology in Mozambique.** Pretoria: USDA Foreign Agricultural Information Service. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnology%20in%20Mozambique_Pretoria_Mozambique_11-1-2013.pdf; accessed 09/04/2015).
53 James, Clive. 2014. **Global Status of Commercialized Biotech/GM Crops: 2014.** *ISAAA Brief* No. 49. ISAAA: Ithaca, NY.
54 ACB. 2013. **African bullied to grow defective Bt maize: The failure of Monsanto's MON810 maize in South Africa.** Johannesburg: African Centre for Biosafety.
55 Van Rooy, A. **IP rights for genetically modified plants and other GMOs.** 1 June 2012. World Intellectual Property Review. http://www.worldipreview.com/article/ip-rights-for-genetically-modified-plants-and-other-gmos; (accessed 08/04/2015).
56 ACB. 2010. **A good neighbour? South Africa forcing GM maize onto African markets and policy makers.** ACB Briefing paper No.16. Johannesburg: African Centre for Biosafety.
57 **GMO Permit lists.** Department of Agriculture, Forestry and Fisheries (DAFF). http://www.daff.gov.za/daffweb3/Branches/Agricultural-Production-Health-Food-Safety/Genetic-Resources/Biosafety/Information/Permits-Issued; (accessed 09/04/2015)
58 James, Clive. 2014. **Global Status of Commercialized Biotech/GM Crops: 2014.** *ISAAA Brief* No. 49. Ithaca, NY: ISAAA.
59 Esterhuizen, D. 2014. **South Africa Agricultural biotechnology annual 2014.** Pretoria: USDA Foreign Agricultural Service. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnology%20Annual_Pretoria_South%20Africa%20-%20Republic%20of_7-14-2014.pdf; (accessed 09/04/2015).
60 ACB. 2013. **African bullied to grow defective Bt maize: The failure of Monsanto's MON810 maize in South Africa.** Johannesburg: African Centre for Biosafety.
61 Ibid.
62 Ibid.
63 Iversen, M., Grønsberg, I.M., Van den Berg, J., Fischer, K. and Aheto D.W. *et al*. 2014. **Detection of Transgenes in Local Maize Varieties of Small-Scale Farmers in Eastern Cape, South Africa**. PLoS ONE 9(12): e116147. doi:10.1371/journal.pone.0116147.
64 Fischer, K., Van den Berg, J. and Mutengwa, C. 2015. **Is Bt maize effective in improving South African smallholder agriculture?** S Afr J Sci. 2015;111(1/2), Art. #a0092, 2 pages. http://dx.doi. org/10.17159/sajs.2015/a0092.
65 Ibid.
66 Trtikova, M., Wikmark, O.G., Zemp, N., Widmer, A. and Hilbeck A. 2015. **Transgene Expression and Bt Protein Content in Transgenic Bt Maize (MON810) under Optimal and Stressful Environmental Conditions.** PLoS ONE 10(4): e0123011. doi:10.1371/journal.pone.0123011
67 http://aatf-africa.org; (accessed 06/02/2015).
68 **AATF and the Commission of the African Union (AU) sign MoU.** 23 January 2012. http://www.aatf-africa.org/news/aatf-news/aatf-and-commission-african-union-au-sign-mou; (accessed 04/02/2015).
69 **Partnerships: Quarterly newsletter of the African Agricultural Technology Foundation (AATF).** No 9, Jan – April 2012. http://www.aatf-africa.org/userfiles/PartnershipsNewsletter_9_Jan-April12.pdf; (accessed 05/02/2015).
70 **Partnerships: Quarterly newsletter of the African Agricultural Technology Foundation (AATF).** No 8, Dec 2010 – Jan 2011. http://www.aatf-africa.org/userfiles/PartnershipsNewsletter_8_Dec10-Jan11.pdf; (accessed 04/02/2015).
71 **AATF project briefs.** http://aatf-africa.org/information/project-briefs; (accessed 04/02/2015).
72 James, Clive. 2014. **Global Status of Commercialized Biotech/GM Crops: 2014.** *ISAAA Brief* No. 49. Ithaca, NY: ISAAA.
73 Gurian-Sherman, D. 2012. **High and dry: Why genetic engineering is not solving agriculture's drought problem in a thirsty world.** Cambridge, M.A: Union of Concerned Scientists.
74 Ibid.
75 Machuka, J., Oduor, R., Runo, S., Adam, R., Matheka, J., Bebdada, L., Miccah, S., Kuria, E., Masiga, C., Mugoya, C. 2012. **Genetic engineering of maize for drought tolerance in Eastern and Central Africa.** ASARECA. http://www.asareca.org/content/genetic-engineering-maize-drought-tolerance-eastern-and-central-africa; (accessed

08/04/2015).

76 http://www.asareca.org/content/first-gm-tropical-maize-africa-how-far-how-soon

77 http://ke.biosafetyclearinghouse.net/approvedcft.shtml; (accessed 20/04/2015).

78 ABNE. 2015. **ABNE in Africa: Towards building functional biosafety systems in Africa.** Ouagadougou: African Biosafety Network of Expertise.

79 DfID, 2014. **Annual review of African Agricultural Technology Foundation (AATF).** June 2014. iati.dfid.gov.uk/iati_documents/4485504.docx; (accessed 25/02/2015).

80 AATF. 2014. **Effective partnerships for accessing and developing technologies for farmers. Annual report 2013.** Nairobi, Kenya: African Agricultural Technology Foundation (AATF).

81 Okech, O. **WEMA celebrates successes at annual meeting.** 24 April 2014. WEMA News. AATF. http://wemanews.aatf-africa.org/?p=5#more-5; (accessed 21/01/2015).

82 Bruce Paterson, SA country manager, Seed Co. Personal correspondence, 16/03/2015.

83 Dr Gospel Omanya, WEMA deployment team leader, African Agricultural Technology Foundation. Interview on 05/03/2015.

84 ACB. 2012. **South Africa's Seed Systems: Challenges for food sovereignty.** Johannesburg/Cape Town: African Centre for Biosafety/Trust for Community Outreach and Education.

85 **WEMA deployment team business process: Q&A reference guide.** 15 August 2012. http://www.aatf-africa.org/userfiles/WEMA-Deployment-Business-Process-QA.pdf.

86 Monitor Deloitte. 2015. **Early generation seed study.** Bill and Melinda Gates Foundation/USAID. https://agrilinks.org/sites/default/files/resource/files/EGS%20Study.pdf; (accessed 16/04/2015).

87 **WEMA deployment team business process: Q&A reference guide.** 15 August 2012. http://www.aatf-africa.org/userfiles/WEMA-Deployment-Business-Process-QA.pdf; (accessed 08/04/2015).

88 Dr Gospel Omanya, WEMA deployment team leader, African Agricultural Technology Foundation. Interview on 05/03/2015.

89 Ngila Kimotho, Managing Director, Dryland Seed. Personal correspondence. 10/04/2015.

90 Dr Gospel Omanya, WEMA deployment team leader, African Agricultural Technology Foundation. Interview on 05/03/2015.

91 **WEMA Intellectual Property Policy**. http://www.aatf-africa.org/userfiles/wema-ip-policy.pdf; (accessed 04/02/2015).

92 Dr Gospel Omanya, WEMA deployment team leader, African Agricultural Technology Foundation. Interview on 05/03/2015.

93 Jarret Abramson, Intellectual Property Counsel, CIMMYT. Personal correspondence, 24/03/2015.

94 **WEMA deployment team business process: Q&A reference guide.** 15 August 2012.

95 AGRA. 2014. **Planting the seeds of a green revolution in Africa.** Nairobi: Alliance for a Green Revolution in Africa.

96 http://pearlcapital.net/our%20investments.php; (accessed 10/04/2015).

97 **Partner updates on the Water Efficient Maize for Africa project.** Issue 56, June, 2014. http://www.arc.agric.za/arc-gci/News%20Articles%20Library/WEMA%20Bulletin%2056%20-%20June%202014.pdf; (accessed 26/03/2015).

98 Gachiri, J. **Pearl Capital injects cash into hybrid seeds distributor.** 25 June 2013. Business Daily Africa. http://www.businessdailyafrica.com/Pearl-Capital-injects-cash-into-hybrid-seeds-distributor/-/539552/1894582/-/2p5qbaz/-/index.html; (accessed 17/04/2015).

99 http://pearlcapital.net/our%20investments.php; (accessed 10/04/2015)

100 **AGRA celebrates the launch of the African Agricultural Capital Fund (AA.CF).** 27 June 2012. Nairobi. http://archive.agra.org/media-centre/news/agra-celebrates-launch-of-african-agricultural-capital-fund-aacf/; (accessed 21/04/2015).

101 Gachiri, J. **Pearl capital injects cash into hybrid seeds distributor.** 25 June 2013, *Business Daily*. http://www.businessdailyafrica.com/Pearl-Capital-injects-cash-into-hybrid-seeds-distributor/-/539552/1894582/-/2p5qbaz/-/index.html; (accessed 21/04/2015).

102 http://www.aecfafrica.org; (accessed 21/04/2015).

103 Ibid.

104 **Commercialisation of a product under the multilateral system in the context of not-for-profit projects under article 13 of the treaty: submission by the WEMA project.** Third Meeting of the *Ad Hoc* advisory technical committee on the standard material transfer agreement and the multilateral system. New Delhi, India, 26–28 June 2012. IT/AC-SMTA-MLS 3/12/6 Rev. 1.

105 Dr Gospel Omanya, WEMA deployment team leader, African Agricultural Technology Foundation. Interview on 05/03/2015.

106 World Bank. 2014. **Agribusiness indicators: Synthesis report.** Washington, D.C.: The World Bank.

107 ACB. 2015. **Nuanced rhetoric and the path to poverty: AGRA, small-scale farmers, and seed and soil fertility in Tanzania.** Johannesburg: African Centre for Biosafety.

108 Ibid.

109 Ibid.

110 One proposed working for landraces is as follows: a landrace is a dynamic population(s) of a cultivated plant that has historical origin, distinct identity and lacks formal crop improvement, as well as often being genetically diverse, locally adapted and associated with traditional farming systems'.

Villa, T.C.C., Maxted, N., Scholten, M. & Ford-Lloyd, B. 2005. **Defining and identifying crop landraces.** *Plant Genetic Resources 3(3); 373-384. DOI: 10.1079/PGR200591*

111 Keyser, J. 2013. **Opening up the markets for seed trade in Africa.** Washington, D.C.: The World Bank.

112 Deloitte Monitor. 2015. **Early generation seed study.** Study commissioned by the Bill and Melinda Gates Foundation and USAID.

113 ETC Group. 2013. **Putting the cartel before the horse ... and farm, seeds, soil, peasants etc.** ETC Group Communique, No.111.

http://www.etcgroup.org/sites/www.etcgroup.org/files/CartelBeforeHorse11Sep2013.pdf; (accessed 19/04/2015).

114 **Acquisition of Africa's Seed Co by Monsanto, Groupe Limagrain: Neo-colonial occupation of Africa's seed systems.** Media advisory by the Alliance for Food Sovereignty in Africa (AFSA). Addis Ababa. 8 October 2014. http://acbio.org.za/index.php/media/64-media-releases/469-acquisition-of-africas-seedco-by-monsanto-groupe-limagrain-neo-colonial-occupation-of-africas-seed-systems; (accessed 19/04/2015).

115 Edmeades, G.O. 2013. **Progress in Achieving and Delivering Drought Tolerance in Maize—An Update**. Ithaca, NY: ISAAA.

116 ACB. 2013. **Africa bullied to grow defective Bt maize: the failure of Monsanto's MON810 maize in South Africa.** Johannesburg: African Centre for Biosafety.

117 Bruce, W., Edmeades, G.O. and Barker, T.C. 2001. **Molecular and physiological approaches to maize improvement for drought tolerance.** Journal of experimental botany. Vol.53, issue 366. Pp. 13–25.

118 Banziger, M., Setimela, P., Hodson, D. and Vivek, B. 2004. **Breeding for improved drought tolerance in maize adapted to southern Africa.** Australian Agronomy conference 2004. http://www.regional.org.au/au/asa/2004/symposia/1/1/152_banzigerm.htm; (accessed 13/02/2015).

119 Jarret Abramson, Intellectual Property Counsel, CIMMYT. Personal correspondence, 24/03/2015.

120 Shadrack Moephuli, CEO, Agricultural Research Council of South Africa. Personal correspondence. 16/03/2013.

121 Ethiopia, Kenya, Tanzania, Uganda, Angola, Malawi, Mozambique, Zambia, and Zimbabwe in Eastern and Southern Africa and Benin, Ghana, Mali, and Nigeria in West Africa.

122 Dr Tsedeke Abata, Leader, DTMA project. Telephonic interview. 23/03/2015.

123 Dr Gospel Omanya, WEMA deployment team leader, African Agricultural Technology Foundation. Interview on 05/03/2015.

124 Mauricio Dengo, managing director, Dengo Seed. Personal correspondence 16/03/2015.

125 Dr Tsedeke Abata, Leader, DTMA project. Telephonic interview. 23/03/2015.

126 Ibid.

127 http://www.twn.my/title2/susagri/susagri112.htm; (accessed 17/04/2015).

128 AGRA. 2014. **Planting the seeds of a green revolution in Africa.** Nairobi: Alliance for a Green Revolution in Africa.

129 Grow Africa secretariat. 2014. **Grow Africa: agricultural partnerships taking place across Africa.** http://www3.weforum.org/docs/IP/2014/GA/WEF_GrowAfrica_AnnualReport2014.pdf; (accessed 20/04/2015).

130 Yared, T.T., Masilwa, R. and Mistry, R. 2014. **Hidden Hunger in South Africa: The faces of hunger and malnutrition in a food-secure nation.** Oxfam International. http://policy-practice.oxfam.org.uk/publications/hidden-hunger-in-south-africa-the-faces-of-hunger-and-malnutrition-in-a-food-se-332126; (accessed 20/04/2015).

131 Ozediz, S. 2012. **The CGIAR at 40: Institutional evolution of the world's premier agricultural research network.** Washington, D.C.: CGIAR Fund Office.

132 Ibid.

133 Ibid.

134 http://www.cgiar.org/who-we-are/cgiar-fund/fundcouncil/membership/; (accessed 23/03/2015).

135 **CGIAR Financial report for year 2013.** Montpellier: CGIAR Consortium office.

136 Literally 'off-site'.

137 http://www.cgiar.org/consortium-news/genebanks-investing-in-biodiversity-for-future-generations/; (accessed 23/03/2015).

138 **Booklet of CGIAR Centre Policy instruments, guidelines and statements on genetic resources, biotechnology and intellectual property rights.**

139 http://www.cimmyt.org/en/cimmyt-s-policy-on-germplasm-distribution; (accessed 25/02/2015).

140 They are deemed 'necessary for the further improvement of such intellectual assets', for example.

141 **CGIAR Principles on the management of intellectual assets.** http://www.cgiar.org/consortium-news/principles-on-management-of-intellectual-assets-approved/; (accessed 20/04/2015).

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