

Extract from:

# Gates to a Global Empire



**OVER SEED, FOOD, HEALTH, KNOWLEDGE  
...AND THE EARTH**

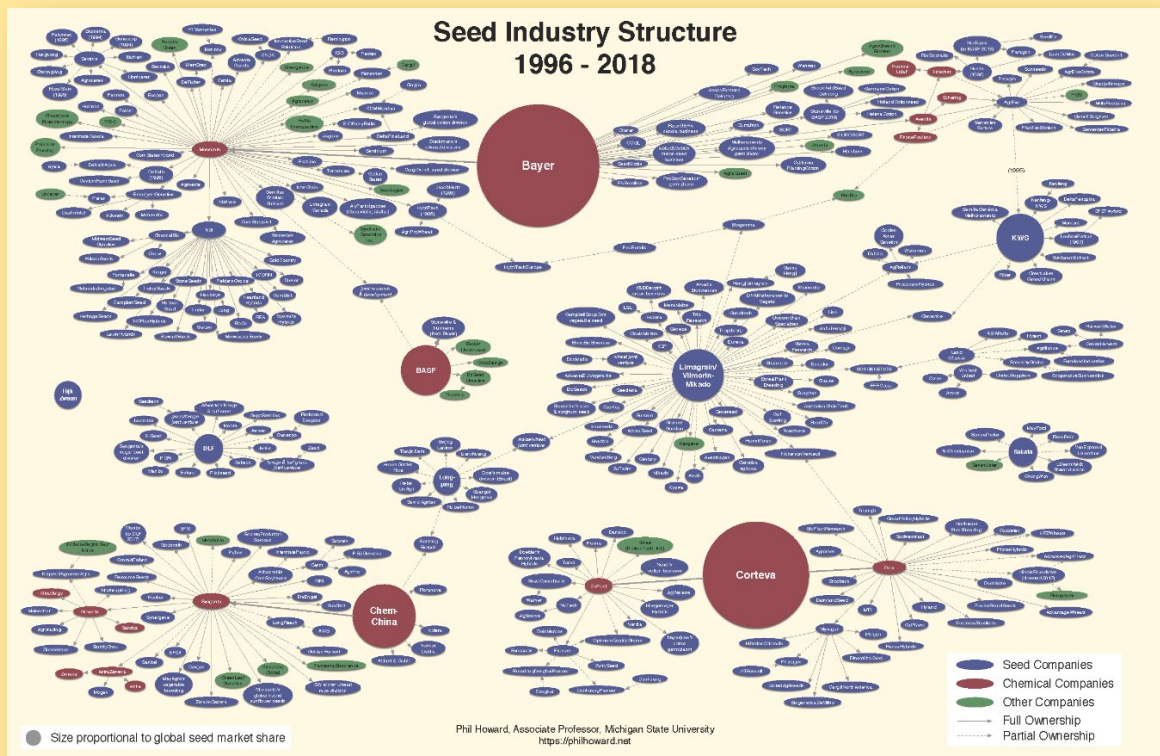
A GLOBAL CITIZENS' REPORT

Coordinated by

 **Navdanya**  
international

## SECTION 1

### ONE EMPIRE OVER SEED, BIODIVERSITY AND KNOWLEDGE



Source: "Global Seed Industry Changes Since 2013." Philip H. Howard, December 31, 2018.  
<https://philhoward.net/2018/12/31/global-seed-industry-changes-since-2013/>



## ONE EMPIRE OVER SEED: CONTROL OVER THE WORLD'S SEED BANKS

Vandana Shiva

Since the onset of the Neolithic Revolution some 10.000 years ago, farmers and communities have worked to improve yield, taste, nutritional and other qualities of seeds. They have expanded and passed on knowledge about health impacts and healing properties of plants as well as about the peculiar growing habits of plants and interaction with other plants and animals, soil and water. The free exchange of seed among farmers has been the basis to maintaining biodiversity and food security.



A great seed and biodiversity piracy is underway, not just by corporations — which through mergers are becoming fewer and larger— but also by super rich billionaires whose wealth and power open doors to their every whim. Leading the way is Microsoft mogul, Bill Gates.

When the Green Revolution was brought into India and Mexico, farmers' seeds were “rounded-up” from their fields and locked in international institutions, to be used to breed green revolution varieties engineered to respond to chemical inputs<sup>1</sup>.

The International Rice Research Institute (IRRI) in the Philippines and the International Maize and Wheat Improvement Centre (CIMMYT), were the first to

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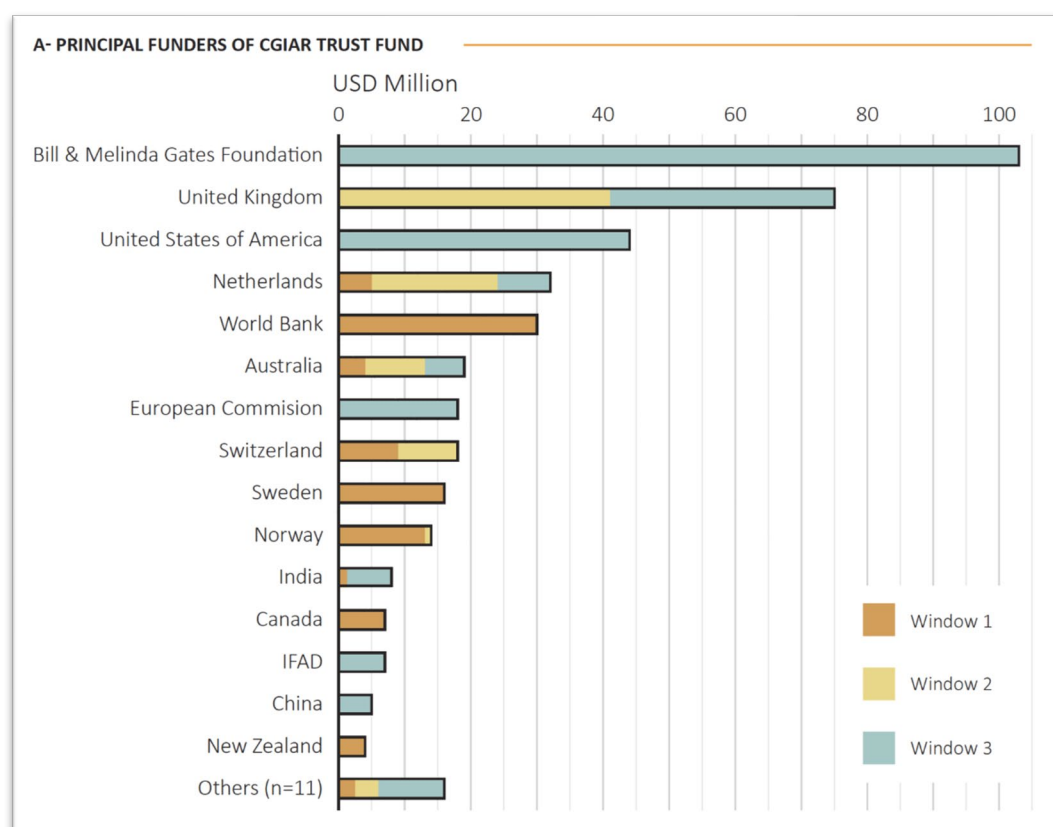
<sup>1</sup> Shiva, V. (1991). *The Violence of the Green Revolution: Third World Agriculture, Ecology, and Politics*. Other India Press. <https://books.google.it/books?id=jPNRPgAACAAJ>

roundup the diversity from farmers' fields and replace it with chemical monocultures of rice, wheat, and corn. Others quickly followed.

This hijacking of farmers' seeds is best highlighted with the shameful removal of India's pre-eminent rice research scientist Dr. R.H. Richaria, as the head of India's Central Rice Research Institute (CRRI) in Cuttack, Orissa, which housed the largest collection of rice diversity in the world, for refusing to allow the IRRI in the Philippines to pirate the collection out of India. With his removal at the behest of the World Bank, Indian peasant intellectual property was hijacked to the IRRI in the Philippines which later became part of the newly created Consultative Group of International Agriculture Research (CGIAR)<sup>2</sup>.

Farmers' seed heritage was held in the private seed banks of CGIAR, a consortium of 15 international agricultural research centers, controlled by the World Bank, the Rockefeller and Ford Foundations, as well as of course the Bill and Melinda Gates Foundation (BMGF), which since 2003, has poured more than \$720 million into the CGIAR centres. CGIAR gene banks presently manage 768,576 accessions of farmer' seeds. Taken together, CGIAR gene banks represent the largest and most widely used collections of crop diversity in the world.<sup>3</sup>

### Principal Funders and main funding channels in 2017



Source: <https://www.cgiar.org/funding-and-finance-highlights-from-2017/>

<sup>2</sup> Alvares, Claude. "The Great Gene Robbery." *Vijayvaani.Com*, January 13, 2012.

<https://www.vijayvaani.com/ArticleDisplay.aspx?aid=2137>

<sup>3</sup> "CGIAR Genebank Platform." CGIAR. <https://www.cgiar.org/the-genebank-platform/>

The Bill & Melinda Gates Foundation operates a bit like the World Bank, using its financial power and prowess to take control of agriculture and influence government and institutional agricultural policies. By far the largest funder of the CGIAR, Gates has successfully accelerated the transfer of research and seeds from scientific research institutions to commodity-based corporations, centralizing and facilitating the pirating of intellectual property and seed monopolies through intellectual property laws and seed regulations.

The urgency with which this restructuring of CGIAR and centralization of control is being done is reflected in the IPES Food open letter of 21 July 2020 as follows: *"The process now underway to reform the CGIAR is therefore imperative and of major public interest. The 'One CGIAR' process seeks to merge the CGIAR's 15 legally independent but cooperating centres, headquartered in 15 countries, into one legal entity. The impetus has come from some of its biggest funders, notably the Bill and Melinda Gates Foundation, the World Bank, and the US and UK governments."*<sup>4</sup>

The aim of "One CGIAR", overseen by "One CGIAR Common Board" is to merge it to become part of "One Agriculture", aka "Gates Ag One" – Gates' latest move in controlling the world's seed supply<sup>5</sup>. Gates has indicated he will more than double the CGIAR present budget, from \$850 million to \$2 billion a year.

Despite the long-recognized failure of the Green Revolution in India and Mexico, in 2006 Gates launched AGRA, the Alliance for a Green Revolution in Africa. The folly of imposing this failed technology in Africa is well documented in the two following articles by Nicoletta Dentico and Tim Wise.

The Seed Freedom movement has been calling for the CGIAR gene banks to return these stolen farmers varieties back to the farmers. The lessons of the Green Revolution since the 1960's have shown us that the chemical path of monocultures has undermined Earth's capacity to support life and food production by destroying biodiversity, soil and water<sup>6</sup> <sup>7</sup>, as well as contributing to climate change<sup>8</sup>. It has dispossessed small farmers through debt for external inputs. And it has undermined food and nutritional security<sup>9</sup>. The experience of the last half century has made clear that Seed Sovereignty, Food Sovereignty and Knowledge Sovereignty is the only viable future of food and farming.

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<sup>4</sup> IPES food. "OPEN LETTER | 'One CGIAR' with Two Tiers of Influence?", July 21, 2020. <http://www.ipes-food.org/pages/OneGGIAR>

<sup>5</sup> Shiva, V., Anilkumar, P., & Ahluwalia, U. (2020). *Ag one: Recolonisation of agriculture*. Navdanya/ RFSTE. <https://navdanyainternational.org/publications/ag-one-recolonisation-of-agriculture/>

<sup>6</sup> IPBES. "UN Report: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating.'" *UN | Sustainable Development*, May 6, 2019.

<https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report> <sup>7</sup> FAO Commission on Genetic Resources for Food and Agriculture. "The State of the World's Biodiversity for Food and Agriculture 2019," 2019. <http://www.fao.org/state-of-biodiversity-for-food-agriculture/en>

<sup>8</sup> "Land Is a Critical Resource, IPCC Report Says". *IPCC*, August 8, 2019. [https://www.ipcc.ch/2019/08/08/land-is-a-critical-resource\\_srccl/](https://www.ipcc.ch/2019/08/08/land-is-a-critical-resource_srccl/)

<sup>9</sup> El Hage Scialabba, Nadia. "Feeding the Word: Delusion, False Promises and Attacks of Industrial Agriculture." *Navdanya International*, December 7, 2019.

<https://navdanyainternational.org/publications/feeding-the-word-delusion-false-promises-and-attacks-of-industrial-agriculture/>





Besides taking control of the seeds of farmers in the CGIAR seed banks, Gates (along with the Rockefeller Foundation) is investing heavily in collecting seeds from across the world and storing them in the Svalbard Global Seed Vault in the Arctic archipelago – aka the Doomsday Vault - created to collect and hold a global collection of the world's seeds. It is in association with the Consultative Group on International Agricultural Research (CGIAR) and the Crop Trust<sup>10</sup>.

The Crop Trust, based in Germany, funds and coordinates the Svalbard Seed Vault. In addition to the Bill and Melinda Gates Foundation, its funders include the Poison Cartel adherents CropLife Dupont/ Pioneer Hi-bred, KWS SAAT AG, and Syngent AG.

The largest numbers of accessions stored in the Seed Vault are varieties of rice, wheat, and barley crops; more than 150,000 samples of wheat and rice, and close to 80,000 samples of Barley. Other well represented crops are sorghum, phaseolus bean species, maize, cowpea, soybean, kikuyu grass and chickpea.

Crops such as potatoes, peanuts, cajanus beans, oats and rye, alfalfa, the cereal hybrid Triticosecale and Brassica's are represented by between 10,000 and 20,000 seed samples.<sup>11</sup>

<sup>10</sup> "India Deposit to the Svalbard Global Seed Vault." *Crop Trust*, May 15, 2014.

<https://www.croptrust.org/blog/india-deposit-svalbard-global-seed-vault/>

<sup>11</sup> Mooney, Chris. "Why the World Is Storing so Many Seeds in a 'Doomsday' Vault." *Washington Post*, April 15, 2016. <https://www.washingtonpost.com/news/energy-environment/wp/2016/04/15/why-the-world-is-spending-half-a-billion-dollars-to-protect-humble-seeds/>

## CROP TRUST DONORS

DONORS	RECEIVED US\$
Australia	20,165,706
Bundesverband Deutscher Planzenzuechter	25,735
CropLife International	43,726
Czech Republic	40,000
Dupont/ Pioneer Hi-bred	2,000,000
Egypt	25,000
Ethiopia	25,000
Gates Foundation/UN Foundation	8,003,118
Germany	50,726,348
India	456,391
International Seed Federation	80,785
Ireland	4,144,250
KWS SAAT AG	35,589
Norway	31,491,161
Netherlands	489,000
New Zealand	1,453,800
Republic of Korea	442,556
Slovak Republic	20,000
Spain	2,629,650
Sweden	11,886,620
Switzerland	10,992,704
Syngenta AG	1,000,000
United Kingdom	19,468,582
United States – before Farm Bill	42,825,073
United States – US Farm Bill*	11,585,120
<b>Sub Total</b>	<b>220,055,915</b>
<b>Concessional Loan **</b>	<b>59,055,611</b>
<b>Sub Total</b>	<b>59,055,611</b>
<b>Grand Total</b>	<b>279,105,526</b>

Source: 'Our Donors'. Crop Trust, <https://www.croptrust.org/about-us/donors/>.

It should come as no surprise that Gates is also funding Diversity Seek (DivSeek), a global project launched in 2015 to map the genetic data of the peasant diversity of seeds held in gene banks to then take patents on these seeds through genomic mapping<sup>12</sup>. Seven million crop accessions are in public seed banks.

**Biopiracy is carried out through the convergence of information technology and biotechnology where patents are taken on seeds through “mapping” their genomes and genome sequences.**

While living seed needs to evolve “in situ”, patents on seed genomes can be taken from seed “ex situ. DivSeek is designed to “mine” and extract the data in the seed to “censor” out the commons. In effect it robs the peasants of their seeds and knowledge, it robs the seed of its integrity and diversity, it erases evolutionary history and the seed’s link to the soil, reducing it to a simple “code”. This ‘genetic colonialism’ is an enclosure of the genetic commons<sup>13</sup>.

The participating institutions in DivSeek are the CGIAR nodes and ‘public’ universities like Cornell and Iowa State, which are being increasingly privatized by the biotechnology industry as well as the Gates Foundation. BMGF funds Cornell’s Alliance for Science, the corporate worlds’ pseudo-science propaganda outlet while Iowa State is the institution promoting the unethical human feeding trials of GMO bananas. Other Gates-funded DivSeek partners are the African Agricultural Technology Foundation and Africa-Brazil Agricultural Innovation Marketplace developed by the Brazilian Agricultural Research Corporation (Embrapa)<sup>14</sup>.

Through a new ‘front’ corporation, Editas Medicine<sup>15</sup>, BMGF is investing in a one-year-old experimental genetic engineering tool for gene editing, CRISPR-Cas9. Though the technology itself is immature and inaccurate, it has become a gold rush for new patents. The language of “gene editing” and “educated guesses” is creeping into scientific discourse.

**Piracy of common genomic data of millions of plants bred by peasants is termed “big data”. Big data however is not knowledge, it is not even information. It is ‘privateered’ data, pirated and privatised.**

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<sup>12</sup> “Two contributions to an integrated, global, accession-level information system for ex situ conservation” | Input Paper to the ITPGRFA Consultation on the Global Information System on Plant Genetic Resources for Food and Agriculture (COGIS-PGRFA) Provided by: The Global Crop Diversity Trust. January 2015. IT/COGIS-1/15/Inf.4.a5. <http://www.fao.org/3/a-be678e.pdf>

<sup>13</sup> “‘DivSeek Initiative’ Loses Support of the International Treaty on Plant Genetic Resources for Food and Agriculture.” *International Planning Committee for Food Sovereignty (IPC)*, February 28, 2017. <https://www.foodsovereignty.org/divseek-initiative-loses-support-international-treaty-plant-genetic-resources-food-agriculture/>

<sup>14</sup> Shiva, V., & Shiva, K. (2020). *Oneness Vs. The 1 Percent: Shattering Illusions, Seeding Freedom*. CHELSEA GREEN PUB. <https://books.google.it/books?id=4TmTzQEACAAJ>

<sup>15</sup> Herper, Matthew. “Bill Gates And 13 Other Investors Pour \$120 Million Into Revolutionary Gene-Editing Startup.” *Forbes*, August 10, 2015. Accessed September 8, 2020. <https://www.forbes.com/sites/matthewherper/2015/08/10/bill-gates-and-13-other-investors-pour-120-million-into-revolutionary-gene-editing-startup/>



Seeds are not just germplasm. They are living, self-organizing entities, subjects of evolution, history, culture, and relationships.

In the 1980s, Monsanto led the push for GMOs and patents on seed and life. Today the flag bearer is Bill Gates. In a nutshell: one billionaire given free access to use his wealth to bypass all international treaties and multilateral governance structures to help global corporations highjack the biodiversity and wealth of peasants by financing unscientific and undemocratic processes such as DivSeek, and to unleash untested technologies such as the CRISPR technology on humanity.

Over the last two decades, thousands of concerned citizens and organizations have taken action and written laws to protect the biodiversity of the planet and the rights of farmers to seed, and the rights of consumers to safety, among them, the Convention on Biological Diversity (CBD); the Cartagena Biosafety Protocol to the CBD; and the International Treaty on Plant Genetic Resources Treaty for Food and Agriculture (ITPGRFA).

Contributors to this report outline how Bill Gates and his foundation routinely undermine international treaties created to protect biodiversity, farmers rights, and the sovereignty of countries and communities of their seed and biodiversity wealth.



## **BMG FOUNDATION AND IRRI: CORPORATE HIJACK OF RICE SCIENCE**

Chito P. Medina

### **The Bill and Melinda Gates Foundation (BMGF)**

**B**ill Gates is one of the richest people on earth who has established the world's largest philanthropic organization, the Bill and Melinda Gates Foundation (BMGF). Organized in 2000, BMGF was reported to have total assets of \$46.8 billion (as of 2018). It has become the world's largest donor, and with it the most influential, in international development particularly in global health and agriculture policy, research, and programs. In fact, its influence in agricultural development is far greater than most countries.

BMGF is the biggest private charitable donor to the CGIAR system, and third overall (after the US and UK) contributing 13 percent of total budget (2014 CGIAR Annual Report). In recognition of its huge contribution, BMGF is the only private/non-governmental voting member in the CGIAR System Council. Over a period of 15 years, BMGF's direct grants to IRRI averaged US\$ 10.3M/yr which amounts to 15 percent of IRRI's annual budget (IRRI audited 2016 financial statement). Out of all of IRRI's bilateral and restricted research funds for 2016, BMGF grants of US\$11.716M constitute 18 percent.

The generous philanthropic contributions of BMGF towards alleviating poverty and hunger would be welcomed except that such contributions carry their own agenda. It attempts to bring simplistic solutions based on science and technology to address the complex problems of hunger and poverty. Such high-end science and technology are, in fact, more aligned to corporate interests rather than the contexts and needs of poor farmers. Importantly, BMGF lacks transparency and accountability. The philanthropic foundation is only accountable to its three trustees, Bill Gates, Melinda Gates and Warren Buffet.

This paper analyzes the grants of BMGF to the Consultative Group on International Agricultural Research (CGIAR), focusing on one of its research centers, the International Rice Research Institute (IRRI).

### **The International Rice Research Institute (IRRI)**

The International Rice Research Institute (IRRI) was established in the Philippines on April 4, 1960 by the Rockefeller Foundation and Ford Foundation "to feed the world" within a Malthusian framing. Its signature program was called the 'Green Revolution' (GR) in rice. Implicit in the name of the program, it is alluded to as an alternative in order to contain the spreading red revolution/communism of those years.

IRRI's GR in rice is actually composed of a package of technology centered on 'high yielding variety' seeds, under conditions of high fossil energy-based inputs (fertilizers, pesticides, machinery), irrigation, and production loans. It was successful in converting rural peasant farming into the capitalist market economy. This helped pave the way for globalization and corporate control of agriculture and food systems.



In a broader picture, similar international research centers on agriculture, forestry, and fishery were established, and in 1971, the Consultative Group on International Agricultural Research (CGIAR) was formed to serve as a coordinating body through which funds for international agricultural research could be administered to its 15 research centers. Being the biggest private donor to CGIAR, Bill Gates now sits in the CGIAR Fund Council. The Chair of CGIAR is a senior vice president of the World Bank.

IRRI, as an international research organization, appears to be public—hence it projects as an unquestioned public interest institution, but it is not. IRRI is a not for profit organization. Research donors are governments, foundations, and business corporations. It has tremendous power to influence the direction of agricultural research, but it lacks public accountability. In fact, IRRI in the Philippines is protected by law (Presidential Decree 1620) and is immune/not accountable to any adverse effects of its research and technology.



*"Golden Rice grain compared to white rice grain in screenhouse of Golden Rice plants", by International Rice Research Institute (IRRI) is licensed under CC BY 2.0 (<https://creativecommons.org/licenses/by/2.0/>).*

Who determines IRRI's Agenda? Gone were the days when science is unquestionably for the public good. IRRI is always on the path of 'modernization' of agriculture which is unmistakably industrial farming. Its agenda is guided by corporate values, influenced by corporate representatives, and often determined by its funding sources. In fact, there is a funding mechanism (Window 3 funds) wherein the donor designates to individual research centers for specific purposes. It used to be called **commissioned research**, but perhaps realizing the very private image of the term, they now call it **bilateral restricted funding**. This means that the funds provided by the donor are for predetermined, specific activities and outputs. Often, any commercializable results are reserved for the funding donor.

## BMGF funding to CGIAR and IRRI

Over a span of 13 years (2008-2020), BMGF has granted a total of US\$1.136 Billion funding to 12 CGIAR research centers and the CGIAR system organization (Table 1). In fact, it contributes 13 percent of its entire budget. As mentioned above, BMGF is the third largest donor (next to US and UK) and the largest private donor.

From 2008 to 2020, BMGF has funded 15 projects of IRRI for a total of US\$ 154,544,972 (Table 2). Over the years, the foundation has been contributing an average of 15 percent of IRRI's budget per year. On a yearly basis, BMGF contributed 18 percent of all research grants in 2016 (IRRI 2016 Audited Financial Statements), and 64 percent of all the Bilateral Restricted research grants in the same year.

**Table 1. Project grants funded by Bill and Melinda Gates Foundation to the CGIAR and its research centers (2008-2020).**

<b>Agricultural Research Center</b>	<b>No. of Projects</b>	<b>Total Grants (US \$)</b>
Int'l. Maize and Wheat Improvement Center (CIMMYT)	25	280,155,682
Int'l. Food Policy Research Institute (IFPRI)	27	174,869,347
Int'l. Institute of Tropical Agriculture (IITA)	26	158,602,630
<b>International Rice Research Institute (IRRI)</b>	<b>15</b>	<b>154,544,972</b>
Int'l. Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	11	127,934,330
International Potato Center (CIP)	11	90,588,729
Int'l. Livestock Research Institute (ILRI)	16	65,907,489
Int'l. Center for Tropical Agriculture (CIAT)	13	29,229,888
World Agroforestry Center (ICRAF)	3	18,917,317
Int'l. Water Management Institute (IWMI)	1	9,012,826
Africa Rice Center	3	6,004,502
Bioversity International	3	5,097,884
Center for Int'l. Forestry Research (CIFOR)	0	--
Int'l. Center for Agric. Research in the Dry Areas (ICARDA)	0	--
WorldFish	0	--
<b>SUB-TOTAL (Research)</b>		<b>1,120,865,596</b>
CGIAR System Organization	4	15,494,677
<b>GRAND TOTAL</b>		<b>1,136,360,273</b>

Extracted from <https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants> (accessed June 8, 2020)



There are at least five big research projects funded by BMGF in IRRI.

- The first was the 'Realizing Increased Photosynthetic Efficiency' (RIPE) program that started in 2008 and lasted for seven years where BMGF contributed US\$19.4 M. It was touted as an innovative scientific research program attempting to make rice, a C3 plant, into a C4 plant in order to make it more efficient in photosynthesis for higher grain production, through genetic engineering. A C4 super rice was projected to produce 50% more yield and significantly contribute to global food security. To date, except for some knowledge gained, there is no tangible C4 super rice produced.
- The second IRRI project funded by BMGF is genetically engineered golden rice. The first phase lasted from 2010 to 2017 with a total grant of more than US\$ 10M, and the second phase from 2017 to 2022 with a total grant of US\$ 18 M. It aims to be able to reach the approved commercial stage in Bangladesh and in the Philippines, by then. Despite strong people's opposition, this overwhelming funding to push golden rice is too big to reckon with in the fight against this GMO.
- Third is the Stress Tolerant Rice for Africa and South Asia (STRASA) project focusing on development of seed systems tolerant to drought, submergence, salinity, iron toxicity, cold, and biotic stress. The first and second phases were implemented from 2007 to 2010 and 2011 to 2014 with US\$ 20 M for each phase, and a third phase from 2014 to 2019 with a budget of US\$ 32.77M. Perhaps the most publicized output is Swarna-Sub1 rice or scuba rice. The gene used here came from naturally occurring local Indian rice variety Swarna, and bred to modern varieties using marker assisted selection.
- Fourth is Transforming Rice Breeding (TRB) which was implemented from 2013 to 2018 with a budget of US\$12.5 M. It focused on rice germplasm development and networking of trial and testing of newly developed varieties.
- Fifth, Accelerated Genetic Gain in Rice in South Asia and Africa (AGGRi) Alliance was organized from the merger of STRASA and TRB with a new funding of US\$34.99M from BMGF. It aims to modernize and unify existing rice breeding efforts and strengthen its partnership with the National Agricultural Research and Extension System (NARES) to increase rice yield and improve livelihood of rice farmers in South Asia and Africa.

Another significant BMGF supported program where IRRI is involved (IFPRI and CIAT are the project holders) is Harvest Plus otherwise referred to as Challenge Program. This program started in the early 1990s, but BMGF started supporting it in 2003. It is a very big alliance of nine CGIAR research centers, universities, private sector, NGOs, and other international/national agricultural research institutes. This program aims to develop crops to provide higher levels of micronutrients such as iron, zinc, and vitamin A through biofortification. Rice biofortification is done through conventional breeding (high zinc rice), transgenic biofortification (Golden rice) and gene editing biofortification (high zinc rice).

In its networking mechanism, IRRI is the convenor and secretariat for the Global Rice Science Partnerships (GRiSP) which are also indirectly supported by BMGF through other programs. This influences and unifies all research activities on rice science.

Lastly, IRRI is the secretariat of the Hybrid Rice Research and Development Consortium (HRRDC) organized in 2007. HRRDC laid down the foundation for a direct relationship between IRRI and private seed companies, with the former providing parent lines to the latter. GRiSP, AGGRi Alliance and HRRDC are big networks for the consolidation, diffusion, and with it, influence on rice research, development, and farming.

**Table 2. BMG Foundation Funding Granted to IRRI from 2008 to 2019.**

YEAR	AMOUNT(US\$)	PURPOSE OF PROJECT
<b>RIPE Program (Realizing Increased Photosynthetic Efficiency)</b>		
2008 (to 2012)	11,017,675	to increase yield by increase the photosynthetic efficiency of rice (44)
2012 (to 2016)	8,375,747	to increase yield by increasing the photosynthetic efficiency of rice (43)
<b>Golden Rice Project</b>		
2010 (to 2017)	10,287,784	to address the problem of Vitamin A deficiency among millions of people in the Philippines and Bangladesh (83)
2017 (to 2022)	18,000,000	to develop and deploy healthier rice varieties genetically engineered to improve the nutritional and health status of the poor in Asia, particularly in Bangladesh and the Philippines (63)
<b>STRASA (Stress Tolerant Rice For Africa and South Asia Project)</b>		
2011 (to 2014)	20,000,000	to develop and disseminate stress-tolerant rice varieties for smallholder farmers in Africa and South Asia. (37)
2014 (to 2019)	32,770,000	to reduce poverty and hunger and increase food and income security for farm families and rice consumers in South Asia and sub-Saharan Africa through the development and dissemination of high-yielding rice varieties tolerant of abiotic stresses (61)
<b>TRB Project (Transforming Rice Breeding)</b>		
2013 (to 2018)	12,500,000	to significantly increase the efficiency and genetic gain in irrigated rice breeding programs by using modern breeding tools and approaches to increase food and income security of resource-poor farmers, and to ensure rice food security in Asia and Africa (61)
<b>AGGri Alliance (Accelerated Genetic Gain in Rice in South Asia and Africa), merged TRB and STRASA</b>		
2018 (to 2023)	34,990,000	to unify existing rice breeding efforts targeting South Asia and Sub-Saharan Africa into a system capable of sustainably delivering genetic gain in farmers' fields (60)
<b>Other Project Grants</b>		
2008	22,128.658	to decrease hunger and poverty in South Asia by increasing rice, wheat and maize production (43)
2009	96,869	to support the Conference in Beijing, China in connection with the IAAE conference (30)
2010	600,000	to monitor the diffusion of improved crop varieties in rainfed areas of South Asia (40)
2013	690,327	to conduct pilot survey to monitor varietal adoption and rice production in South Asia (12)

2014	3,359,914	to increase rice productivity in South Asia and improve agricultural policies (54)
2016	880,000	to help Indian and Bangladeshi rice breeding programs deliver higher rates of genetic gains in the farmers' fields by improving product design, shorten breeding cycles, increase selection pressure, and improve heritability (50)
2019	954,527	to evaluate the effectiveness of the organization and identify potential improvements in strategy, management, and partnership that could enhance the rate of genetic gain delivered to smallholder farmers (16)

Extracted from <https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants> (accessed June 15, 2020)

## Outcome of IRRI Science

The introduction of IRRI's modern rice varieties through the Green Revolution has caused genetic erosion wherein a majority of local rice varieties in rice growing countries have disappeared. In Indonesia, some 1,500 traditional rice varieties and landraces disappeared between 1975 and 1990; in India, some 30,000 rice varieties is down to just 10 varieties in 75% of its rice (Ryan, 1992); 99% of rice fields in Pakistan were planted with only four High Yielding Varieties (HYV) (IRRI World Rice Statistics, 2004); and at least 85% of the rice fields in Burma, Indonesia, Philippines, and Thailand are occupied by HYVs (WRI, UNEP and IUCN, 2002). The associated biodiversity in rice fields were also displaced due to monocultures. Edible fish, snails, crustaceans, and plants were killed by pesticides. Due to intensive planting and reliance on synthetic fertilizers, soil nutrient imbalance and depletion became prevalent. Pests and diseases had periodic outbreaks due to high nitrogen levels, overuse of pesticides, and crop management practices. Water, soil, biodiversity, and humans were poisoned by pesticide residues. The expensive inputs of seeds, fertilizers, and pesticides became an economic burden to farmers and many became bankrupt. The pervasive modern rice technology developed in IRRI, supported by aggressive government extension work, made farmers 'forget how to grow rice'.

IRRI is a tool for privatizing farmers' seeds. They have collected 132,442 rice accessions from farmers and stored them in their gene bank, with a duplicate in the Svalbard seed vault in Norway. They value farmers' rice varieties, only because of their genetic diversity but they never acknowledge the associated farmers' knowledge, and the seed diversity that farmers developed is neither officially recognized nor honored. Instead, IRRI, in partnership with Diversity Seek are doing genome sequence mapping of the seeds in the 'public seed banks' and taking patents. By genetic characterization, IRRI and DivSeek are dematerializing the farmers' seeds and committing biopiracy of seed commons because they are dealing with the non-material dimensions (gene sequence) of the farmers' seeds.

Rice science in IRRI is now biased towards technologies that are covered by Intellectual Property Rights (IPR), particularly in breeding, genetic engineering, gene editing, and towards synthetic biology. For example, genetically engineered Vitamin A rice; gene editing for zinc enhanced rice; Phosphorus starvation tolerance gene (PSTOL1) to solve phosphorus deficiency; looking for rice gene to reduce methane emission and many more. These are cutting edge science but there are so many practical, ecological, cost-effective, and affordable

alternatives. These approaches are in fact aligned with corporate interests of commodified seed products, and conversely, farmers' loss of seed control, undermining localized, practical, safe, sustainable, affordable approaches.

IRRI's solution to climate change is through exploitation of genetic resources mainly through biotechnological approaches. This approach creates uniform genetic makeup rather than diversification in breeds and varieties, species and management approaches. As such, this is not reliable in an unpredictable climate change.

Restricted research can be assumed to be beneficial to IRRI because it adds to their research fund portfolio. However, it might be turning into the opposite/having an opposite effect. It is the research fund donors that benefit because they are in effect being subsidized by IRRI through its existing resources such as salaries of researchers in plantilla position, laboratory equipment, and use of other existing facilities. In some of the restricted or commissioned research, any commercializable results are reserved for the funder.

### **BMGF as tool for corporate hijack of rice science**

With the huge funding granted for agricultural research to produce modern science and technology in order to address hunger and poverty, one is tempted to praise Mr. Bill Gates for his humanitarian character. However, there are serious concerns beneath the veneer of his philanthropy. His big actions have a particular narrative or framing that is inconsistent with the root causes of hunger and poverty. His narrative of a Malthusian framework and solutions can emanate purely from technical and scientific developments. Poverty and malnutrition actually is more complex than that, and it is the structures that perpetuate these problems that need to be fixed. Often, poverty is brought about by precarious assets and livelihood, discriminating social relations, lack of security, disempowerment, and lack of democracy. To fix such socio-political problems with expensive technological fixes will not work, no matter how sincere the philanthropic donor might be. It only aggravates and perpetuates the problem it is intending to solve.

Supporting modern farming with the use of chemical fertilizers and pesticides will only create more environmental and socio-economic and health problems as shown by the outcome of the first Green Revolution. Even if there will be successes in chemical farming or industrial agriculture, such would be ephemeral because they are not sustainable. Other than productivity, Mr. Gates is missing equity (intragenerational justice) and sustainability (intergenerational justice) which are equally important in rural development.

Mr. Gates' strong push for GMOs and its modern versions of gene editing and synthetic biology creates more serious and intense problems. Health problems associated with exposure to GMOs had been elucidated in scientific literature, yet proponents like Mr. Gates deny the problems. Contamination of biodiversity and the environment had been reported in scientific literature, but the proponents refuse to open their eyes. Unreliability of the genetic mutilation processes had been reported yet proponents refuse to listen. And so, people wonder why? This is because GMOs are patented, and it would be advantageous to the biotech seed and agrochemical companies. Corporate interest in GMOs is undeniable, and with the full support of Mr. Gates for GMOs, he is inevitably promoting corporate interests.



With funding in agricultural research, BMGF and IRRI (and CGIAR) easily influence and co-opt the National Agricultural Research and Extension System (NARES) of governments through the IRRI network, through advice, staff training, seed distribution and technology. For example, the Global Rice Science Partnership (GRiSP), another program collaboration of IRRI, lists 302 NARES partners. This means that national research and extension institutions are harmonized and homogenized, all in framing, focus and approaches, thereby setting aside other approaches which are more sustainable, and equitable. For example, organic approaches to farming, agroecology, permaculture, etc. would be labeled as second-class science because it does not conform to the cutting-edge science of Mr. Gates. With such homogenization of approaches, any unforeseen or unintended results would be more catastrophic.

Bill Gates, through his BMGF Foundation has hijacked agricultural science in rice into a corporate science. First, it focuses on the very expensive cutting-edge science of genomics, gene editing and synthetic biology that can't be afforded by most NARES in many countries. Second, the resulting technology (seeds) are covered by intellectual property rights (IPR) which can be turned to a business entity for corporate benefits. Farmers buy the seeds at exorbitant prices, making the farmers poorer while the corporations accumulate huge wealth. If the cycle goes on, this creates corporate philanthropy.

Corporate power has extended so well in science that any finding against the interest of corporations can be suppressed by interested parties. There have been uncovered situations where corporations hire scientists to make biased research to counteract any damaging independent science to their business. They can simply turn down publication of research results inimical to the interest of corporate business.



*Chito P. Medina at Food, Farming, Freedom Conference 2019*

Currently, no assessments have been done into whether the intentions of BMGF are indeed successfully achieved. Generosity does not automatically make positive results and success on societal objectives. Because of the potential magnitude of impacts of BMGF philanthropic funding on research and policies, there is a need for transparency and accountability and mechanisms of assessments.

## Conclusion

The generous philanthropy of BMGF is actually more generous to corporate interests than the poor and hungry. It pursues industrial and chemical farming which are expensive and unsustainable. One thing is sure, the science and technology emanating from the BMGF's support makes biotech, agrochemical corporations and agribusiness control agriculture and food. It is corporate philanthropy.

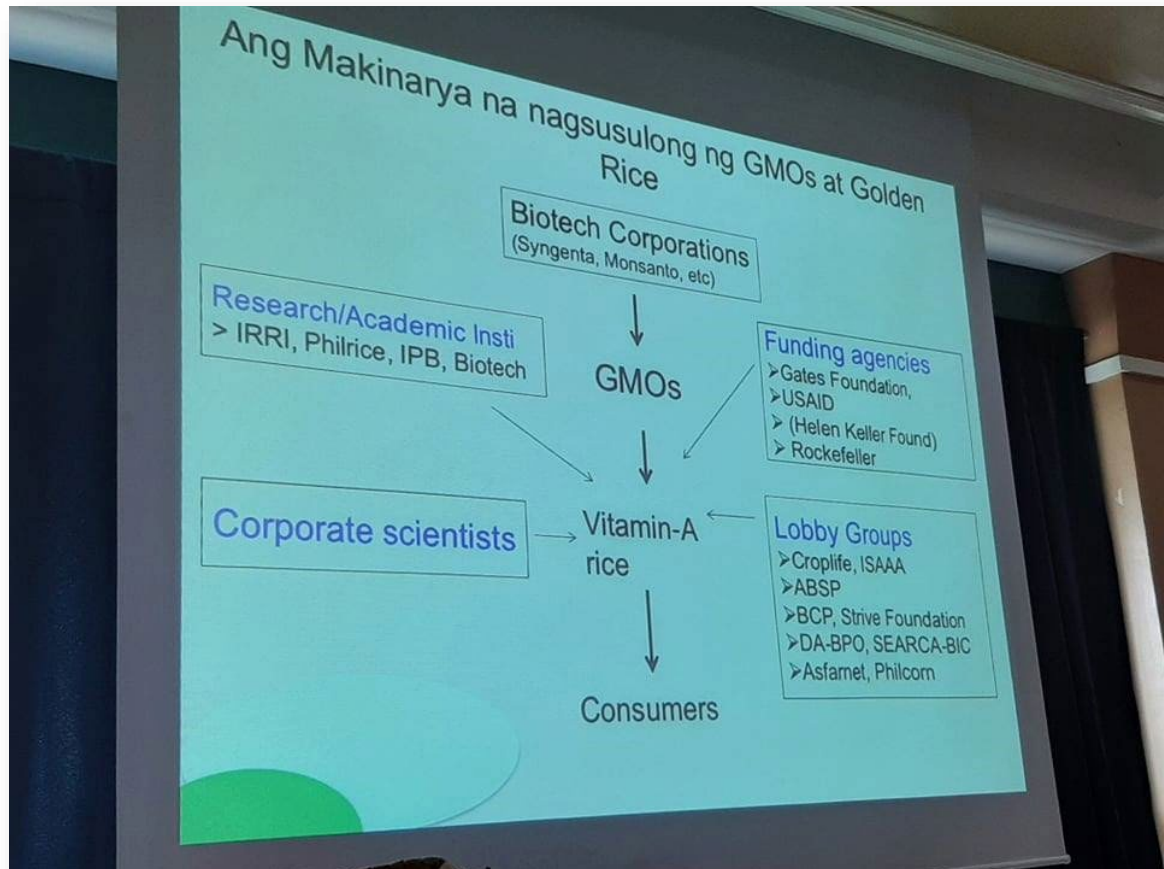


Photo: Food, Farming Freedom Conference 2019

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## OWNING SEEDS THROUGH PATENTS AND NEW GENE EDITING GMO TECHNOLOGIES

Vandana Shiva

**W**e are witnessing today an acceleration of technological revolutions in all fields and concentration of economic power in the hands of a small number of super wealthy individuals and organizations and competing forces throwing all caution to the winds in their haste for unfettered profits and power.

Such is the case with gene editing.

Bill Gates is a big player in both promoting the old failed GMOs, including the GMO banana, Golden Rice and Bt Eggplant, as well as new GMOs based on gene editing and gene drives<sup>1</sup>

Life is self-organised creative complexity.

Living organisms are complex self-organizing evolving systems. When genes are added, edited, or removed through genetic engineering, the self-organizing capacity of living systems is disrupted. But the self-organizing organism will nonetheless continue to evolve. How it will evolve is unpredictable and unknown.

To impose a mechanical, reductionist paradigm on evolving, living systems creates new hazards and unpredictable consequences as evidenced in the widespread failure of the first generation of GMOs.

Gates mechanistic view of life likens it to a Microsoft programme, and cutting and pasting living organisms is simply the next step in patenting and owning the next commodity.

As is typical in our times of post truth, Gates and the biotechnology industry are pushing a new technological tool, gene editing and gene drives as a precision and time efficient technology, though unpredictable and unreliable, as a magic bullet for every problem in agriculture and health. In their haste, they side-step any regulation<sup>2</sup> and don't give a minute's thought to the attendant ethical, moral and safety concerns. For them, each magic bullet will become a patent which will bring immeasurable profit<sup>3</sup>.

CRISPR, the new diamond in genetic engineering, has been described as "a relatively easy way to alter any organism's DNA, just as a computer user can edit a word in a document"<sup>4</sup>.

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<sup>1</sup> Shiva, V., & Shiva, K. (2020). *Oneness Vs. The 1 Percent: Shattering Illusions, Seeding Freedom*. CHELSEA GREEN PUB. <https://books.google.it/books?id=4TmTzQEACAAJ>

<sup>2</sup> Husted, Kristofor. "Dupont Develops Corn Using New CRISPR Technology," April 27, 2016. <https://www.kmuw.org/post/dupont-develops-corn-using-new-crispr-technology>

<sup>3</sup> Stoye, Emma. "Crispr-Edited Mushroom Dodges Regulation." *Chemistry World*, April 26, 2016. <https://www.chemistryworld.com/news/crispr-edited-mushroom-dodges-regulation/1010298.article>

<sup>4</sup> Pollack, Andrew. "Jennifer Doudna, a Pioneer Who Helped Simplify Genome Editing." *The New York Times*, May 11, 2015, sec. Science. <https://www.nytimes.com/2015/05/12/science/jennifer-doudna-crispr-cas9-genetic-engineering.html>

Gates has been quick to invest and promote CRISPR technology, funding the two leading biochemists developing the technology, Jennifer Doudna, University of Berkeley, California, and Feng Zhang, MIT McGovern Institute and the Broad Institute<sup>5</sup>.

It is a simple yet powerful tool for editing genomes in seemingly any organism on Earth, including humans, allowing researchers to easily alter DNA sequences and modify gene function<sup>6</sup>. It should come as no surprise that the technology is eliciting major concerns and ethical and moral questions<sup>7</sup>.

The paradigm of genetic engineering is based on genetic determinism and genetic reductionism. It is based on a non-acceptance of the self-organised, evolutionary potential of living organisms and treats living organisms as a Lego play set. But it is not child's play. Life is complex, self-organised, dynamic evolution – autopoietic.

As Jonathan Latham cautions, ordinary CRISPR “can induce mutations at sites that differ by as many as five nucleotides from the intended target”, i.e. CRISPR may act at unknown sites in the genome where it is not wanted (Fu et al., 2014)<sup>8</sup>. This shows how unreliable and misinformed are the assumptions and projections that genome editing techniques like CRISPR are precise, predictable, and therefore safe and so need for Biosafety regulation.

Bill Gates and 13 other investors have poured \$120 million into a “revolutionary gene-editing startup” ‘Editas Medecine’ a new leading genome editing company focusing on CRISPR genome editing systems - co-founded by Feng Zhang<sup>9</sup>. The piracy of common genomic data of millions of plants bred by peasants is termed “big data”. But big data is not long-held farmers intellectual knowledge. It is biopirated and privateered data. As Editas has stated “Investing in intellectual property is one component how we are building the company to be a leader in genomic medicine,”<sup>10</sup>. Its lead investor is a newly created firm

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<sup>5</sup> Sanders, Robert. “Gates Foundation Awards \$100,000 Grants for Novel Global Health Research.” *Berkeley News*, May 10, 2010. <https://news.berkeley.edu/2010/05/10/gates-foundation/>

<sup>6</sup> “What Is CRISPR-Cas9?” *Yourgenome*, n.d. <https://www.yourgenome.org/facts/what-is-crispr-cas9>

<sup>7</sup> Otieno MO (2015) CRISPR-Cas9 Human Genome Editing: Challenges, Ethical Concerns and Implications. *J Clin Res Bioeth* 6: 253.doi: 10.4172/2155-9627.10002. <https://www.longdom.org/open-access/crisprcas9-human-genome-editing-challenges-ethical-concerns-and-implications-2155-9627-1000253.pdf>

<sup>8</sup> Latham, Jonathan. “God’s Red Pencil? CRISPR and Myths of Precise Genome Editing.” *Independent Science News | Food, Health and Agriculture Bioscience News*, April 25, 2016. <https://www.independentsciencenews.org/science-media/gods-red-pencil-crispr-and-the-three-myths-of-precise-genome-editing/>

Fu Y, Sander JD, Reyon D, Cascio VM, Joung JK. Improving CRISPR-Cas nuclease specificity using truncated guide RNAs. *Nat Biotechnol*. 2014 Mar;32(3):279-284. doi: 10.1038/nbt.2808. Epub 2014 Jan 26. PMID: 24463574; PMCID: PMC3988262.

<sup>9</sup> Herper, Matthew. “Bill Gates And 13 Other Investors Pour \$120 Million Into Revolutionary Gene-Editing Startup.” *Forbes*, August 10, 2016. <https://www.forbes.com/sites/matthewherper/2015/08/10/bill-gates-and-13-other-investors-pour-120-million-into-revolutionary-gene-editing-startup/>

<sup>10</sup> Begley, Sharon . “CRISPR Patent Fight: The Legal Bills Are Soaring.” *STAT*, August 16, 2016. <https://www.statnews.com/2016/08/16/crispr-patent-fight-legal-bills-soaring/>



called BioNano Genomics (bng0), a select group of family offices led by Boris Nikolic, who was previously a science advisor to Bill Gates. Both Editas and Gates' office confirm that the Microsoft billionaire, who is the world's second richest man, is a major investor in the genomic firm bng0<sup>11</sup>.

Thus biotechnology, information technology, and financial technology are being integrated into one mega machine, transforming life into a money making casino.

It is of note that Doudna and Editas (Zheng), both heavily funded by Gates, are engaged in a patent battle on CRISPR technologies. No matter who loses, Gates wins<sup>12</sup>.

The attempt to deregulate new gene edited GMOs and rushing them commercially on the market is to falsely assert they are "natural". However, new research has established that Gene editing is not "natural", that it can in fact be tested, and therefore should be regulated for Biosafety as a GMO<sup>13</sup>.

The European Court of Justice in July 2018 had ruled that CRISPR is a gene modification technology and needs to be regulated like all GMOs. "In today's judgment, the Court of Justice takes the view, first of all, that organisms obtained by mutagenesis are GMOs within the meaning of the GMO Directive, in so far as the techniques and methods of mutagenesis alter the genetic material of an organism in a way that does not occur naturally. It follows that those organisms come, in principle, within the scope of the GMO Directive and are subject to the obligations laid down by that directive"<sup>14</sup>.

This ruling was put to the test in the UK when the House of Lords voted against a Trojan amendment' 275 in the Agriculture Bill which was pushing to introduce gene editing as "natural"<sup>15</sup>.

It can be assumed that the industry hopes that the introduction of the new gene edited GMOs will cover up the failure of old GMOs – the failure of Bt cotton to control pests and the failure of Roundup Ready crops to control weeds.

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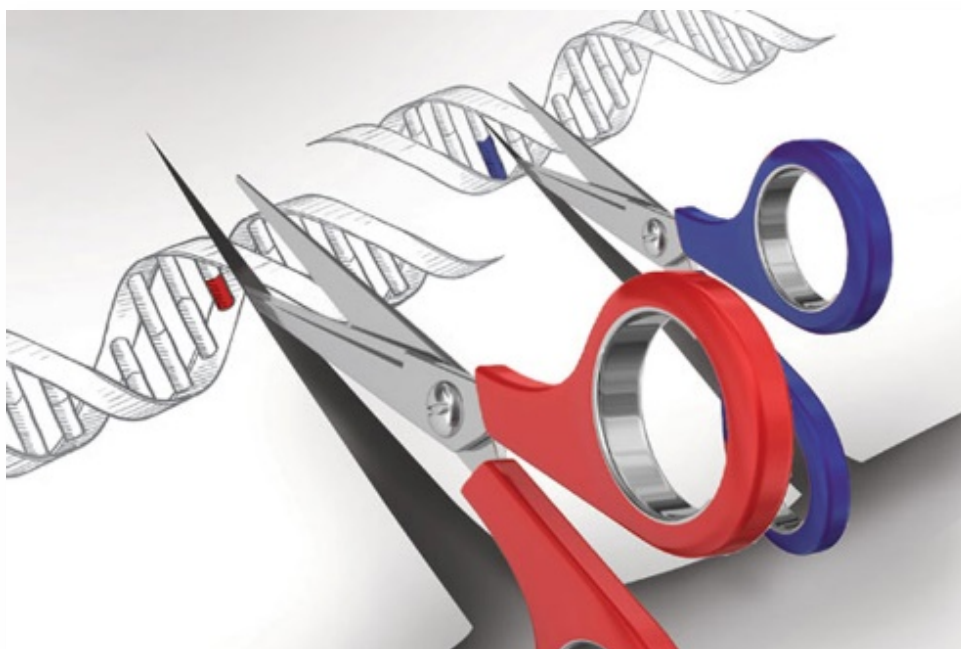
<sup>11</sup> "Bng0 - Company Profile." BCIQ. <https://bcic.biocentury.com/companies/bng0>

<sup>12</sup> Sanders, Robert. "Twelfth CRISPR Patent Awarded to UC Team." *Berkeley News*, September 3, 2019. <https://news.berkeley.edu/2019/09/03/twelfth-crispr-patent-awarded-to-uc-team/>  
"Crispr-Cas Component Systems, Methods and Compositions for Sequence Manipulation," n.d. <https://patents.google.com/patent/EP2840140A1/en>.

<sup>13</sup> Shiva, Vandana. "Gene Edited Foods Are GMOs: New Research." *Seed Freedom*, September 7, 2020. <https://seedfreedom.info/gene-edited-foods-are-gmos-new-research-establishes-that-gene-editing-is-not-natural-that-it-can-be-tested-and-should-be-regulated-for-biosafety-as-a-gmo/>

<sup>14</sup> Court of Justice of the European Union, PRESS RELEASE No 111/18, Luxembourg, 25 July 2018, Judgment in Case C-528/16, Confédération paysanne and Others v Premier ministre and Ministre de l'Agriculture, de l'Agroalimentaire et de la Forêt, *Organisms obtained by mutagenesis are GMOs and are, in principle, subject to the obligations laid down by the GMO Directive*. <https://curia.europa.eu/jcms/upload/docs/application/pdf/2018-07/cp180111en.pdf>

<sup>15</sup> Citizen Action: <https://www.gmfreeze.org/current-actions/ask-ministers-to-reject-plans-to-deregulate-genome-editing/>  
Action briefing: <https://www.gmfreeze.org/publications/action-briefing-on-agriculture-billamendment-to-de-regulate-genome-editing/>  
Political briefing: [https://beyond-gm.org/wp-content/uploads/2020/07/Genome-Editing\\_Ag-Bill\\_Political-Briefing\\_030720-FINAL\\_updated.pdf](https://beyond-gm.org/wp-content/uploads/2020/07/Genome-Editing_Ag-Bill_Political-Briefing_030720-FINAL_updated.pdf)



Nonetheless, industrial agriculture is still faced with managing the unmanageable problem of superpests and superweeds.

CRISPR technology poses serious health risks. Two studies published earlier this summer found that editing cells with CRISPR/Cas9 could increase the chance that the cells being altered to treat disease could become cancerous or trigger the development of cancer in other cells<sup>16</sup>.

Some high-placed scientists like the former director of the US National Institute of Health, have called for a self-imposed ethical moratorium on CRISPR until more is known, particularly on these germline mutations that could potentially be passed on through generations<sup>17</sup>. The risk of unintended permanent mutation in CRISPR technology calls for the precautionary principle and a moratorium until we have full understanding of the risks involved and the potential harm and mutation to the human body and other species.

CRISPR could potentially permanently alter an entire population. Once out, there is no going back. A failure to properly anticipate *all* the effects and consequences could be apocalyptic<sup>18</sup>.

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<sup>16</sup> Hruska, Joel. "CRISPR Gene Editing May Have Unanticipated Side Effects." *ExtremeTech*, July 24, 2018. <https://www.extremetech.com/extreme/274110-study-suggests-crispr-gene-editing-could-have-unanticipated-side-effects>

<sup>17</sup> Licholai, Greg. "Is CRISPR Worth the Risk?" *Yale Insights*, August 21, 2018. <https://insights.som.yale.edu/insights/is-crispr-worth-the-risk>

<sup>18</sup> Creighton, Jolene. "Gene Drives: Assessing the Benefits & Risks." *Future of Life Institute*, n.d. <https://futureoflife.org/gene-drives-assessing-the-benefits-risks/>

## GENE EDITING: UNEXPECTED OUTCOMES AND RISKS<sup>1 2</sup>

GM Watch, Technical advisor: Dr Michael Antoniou

**M**ore papers have been published on unintended outcomes and risks of gene editing in medical research on human and animal cells and laboratory animals, compared with plants.

The results have implications for the gene editing of farm animals. The problems found with human and animal gene editing are increasingly being confirmed in plant gene editing.

The unintended mutational (DNA damaging) outcomes summarized below occur after the gene-editing tool has completed its task of creating a double-strand DNA break. The mutations occur as a consequence of the cell's DNA repair machinery, over which the genetic engineer has no control. So even if scientists eventually succeed in avoiding off-target mutations, most of the unintended mutations described can still occur at the intended gene-editing site.

This lack of full control of the gene-editing procedure, as well as gaps in our knowledge of outcomes, point to the need for strict regulation of gene editing in food crops and farm animals. Regulation must start from consideration of the genetic engineering process used to create the gene-edited organism ("process-based regulation"), so that regulators know where things can go wrong and what to look for.

### NEED FOR REGULATION

New GM plants do not have a history of safe use and should not be exempted from biosafety assessments.

Eckerstorfer MF et al (2019). *Front Bioeng Biotechnol* 7:31. <sup>3</sup>

Gelinsky E and Hilbeck A (2018). *Environ Sci Europe* 30(1):52. <sup>4</sup>

### CHANGES INDUCED BY GENE EDITING ARE NOT THE SAME AS HAPPENS IN NATURE

Gene editing makes the whole genome accessible for changes – unlike naturally occurring genetic changes.

Kawall K (2019). *Frontiers in Plant Science* 10:525. <sup>5</sup>

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<sup>1</sup> "Gene Editing: Unexpected Outcomes and Risks." *GM Watch*. Last modified August 30, 2020. <https://gmwatch.org/en/67-uncategorised/19499-gene-editing-unexpected-outcomes-and-risks>

<sup>2</sup> For more details on individual studies, see Robinson, Claire, and Michael Antoniou (Technical Advisor). "Science Supports Need to Subject Gene-Edited Plants to Strict Safety Assessments." Last modified November 20, 2019. <https://gmwatch.org/en/news/archive/2019/19223-peer-reviewed-papers-with-results-that-support-the-need-to-subject-gene-edited-plants-to-strict-safety-assessments>

<sup>3</sup> Eckerstorfer, Michael F., Marion Dolezel, Andreas Heissenberger, Marianne Miklau, Wolfram Reichenbecher, Ricarda A. Steinbrecher, and Friedrich Waßmann. "An EU Perspective on Biosafety Considerations for Plants Developed by Genome Editing and Other New Genetic Modification Techniques (NGMs)." *Frontiers in Bioengineering and Biotechnology* 7 (2019). <https://www.frontiersin.org/articles/10.3389/fbioe.2019.00031/full>

<sup>4</sup> Gelinsky, Eva, and Angelika Hilbeck. "European Court of Justice Ruling Regarding New Genetic Engineering Methods Scientifically Justified: A Commentary on the Biased Reporting about the Recent Ruling." *Environmental Sciences Europe* 30, no. 1 (December 20, 2018): 52. <https://enveurope.springeropen.com/articles/10.1186/s12302-018-0182-9>

<sup>5</sup> Kawall, Katharina. "New Possibilities on the Horizon: Genome Editing Makes the Whole Genome Accessible for Changes." *Frontiers in Plant Science* 10 (2019). <https://www.frontiersin.org/articles/10.3389/fpls.2019.00525/full>

## UNINTENDED MUTATIONS

Below is a selection of studies showing different types of unintended mutations resulting from gene editing that can affect the functioning of multiple gene systems. The consequences are an alteration in the plant's protein and biochemical function, which could lead to poor crop performance and/or the production of novel toxins and allergens or higher levels of existing toxins and allergens.

### Off-target mutations

Gene-editing tools, especially CRISPR, are prone to causing mutations (damage) to the organism's DNA at locations other than the intended edit site ("off-target mutations"). This can alter the function of other genes, with unknown consequences to biochemical composition and function.

Wolt JD et al (2016). *The Plant Genome* 9(3):10.3835/plantgenome2016.05.0047. <sup>6</sup>

Zhu C et al (2017). *Trends in Plant Science* 22(1):38–52. <sup>7</sup>

### Large deletions and rearrangements of DNA at both off-target and on-target gene editing sites

Large deletions and rearrangements of the plant's genome, which can involve thousands of base units of DNA, have been observed following CRISPR gene editing. These mutations can affect the functioning of many genes, leading to alterations in the plant's protein and biochemical composition.

Biswas S et al (2020). *Journal of Genetics and Genomics*. May 21.<sup>8</sup>

Kosicki M et al (2018). *Nature Biotechnology* 36:765–771.<sup>9</sup>

Mou H et al. (2017). *Genome Biology* 18:108.<sup>10</sup>

Shin HY et al. (2017). *Nature Communications* 8, 15464 (2017).<sup>11</sup>

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<sup>6</sup> Wolt, Jeffrey D., Kan Wang, Dipali Sashital, and Carolyn J. Lawrence-Dill. "Achieving Plant CRISPR Targeting That Limits Off-Target Effects." *The Plant Genome* 9, no. 3 (2016): plantgenome2016.05.0047.

<https://acsess.onlinelibrary.wiley.com/doi/full/10.3835/plantgenome2016.05.0047>

<sup>7</sup> Zhu, Changfu, Luisa Bortesi, Can Baysal, Richard M. Twyman, Rainer Fischer, Teresa Capell, Stefan Schillberg, and Paul Christou. "Characteristics of Genome Editing Mutations in Cereal Crops." *Trends in Plant Science* 22, no. 1 (2017): 38–52. <https://www.ncbi.nlm.nih.gov/pubmed/27645899>

<sup>8</sup> Biswas, Sukumar & Tian, Jiaqi & Rong, Li & Chen, Xiaofei & Luo, Zhijing & Chen, Mingjiao & Zhao, Xiangxiang & Zhang, Dabing & Persson, Staffan & Yuan, Zheng & Shi, Jianxin. (2020). Journal Pre-proof Investigation of CRISPR/Cas9-induced SD1 rice mutants highlights the importance of molecular characterization in plant molecular breeding. *Journal of Genetics and Genomics*. 10.1016/j.jgg.2020.04.004. <https://www.sciencedirect.com/science/article/pii/S1673852720300916>

<sup>9</sup> Kosicki, Michael, Kårt Tomberg, and Allan Bradley. "Repair of Double-Strand Breaks Induced by CRISPR–Cas9 Leads to Large Deletions and Complex Rearrangements." *Nature Biotechnology* 36, no. 8 (September 2018): 765–771. <https://www.nature.com/articles/nbt.4192>

<sup>10</sup> Mou, Haiwei, Jordan L. Smith, Lingtao Peng, Hao Yin, Jill Moore, Xiao-Ou Zhang, Chun-Qing Song, et al. "CRISPR/Cas9-Mediated Genome Editing Induces Exon Skipping by Alternative Splicing or Exon Deletion." *Genome Biology* 18, no. 1 (June 14, 2017): 108.

<https://genomebiology.biomedcentral.com/articles/10.1186/s13059-017-1237-8>

<sup>11</sup> Shin, Ha Youn, Chaochen Wang, Hye Kyung Lee, Kyung Hyun Yoo, Xianke Zeng, Tyler Kuhns, Chul Min Yang, Teresa Mohr, Chengyu Liu, and Lothar Hennighausen. "CRISPR/Cas9 Targeting Events Cause Complex Deletions and Insertions at 17 Sites in the Mouse Genome." *Nature Communications* 8 (31 2017): 15464. <https://www.ncbi.nlm.nih.gov/pubmed/28561021>



## Creation of new gene sequences leads to new RNA and protein products

Iteration of the genetic code of the targeted gene can produce mutant forms of the protein it encodes for, new RNA, and new protein products. These outcomes can lead to changes in the plant's biochemistry.

Mou H et al. (2017). *Genome Biology* 18:108.

Tuladhar R et al (2019). *Nat Commun* 10, 4056 (2019).<sup>12</sup>

Smits AH et al (2019). *Nat Methods* 16, 1087–1093.<sup>13</sup>

## Gene-editing process-induced mutations

The gene editing process, taken as a whole (including plant tissue culture and GM transformation procedure), induces hundreds of unintended mutations throughout the genome of the plant. This can affect multiple gene functions with unknown consequences to protein biochemistry and metabolic activity.

Tang X et al (2018). *Genome Biology* 19:84.<sup>14</sup>

## Insertion of foreign and contaminating DNA into genome at editing sites

Following creation of a double-strand DNA break by the CRISPR gene-editing tool, the repair can unexpectedly include the insertion and rejoining of the broken DNA ends of the recombination template DNA used in SDN-2 and -3, or the insertion of contaminating DNA present in materials used in the plant tissue culture. This insertion of extraneous DNA in the genome of the plant, which can take place at off-target sites as well as the intended on-target editing site, has the effect of introducing new gene functions, as well as disrupting the function of host genes. These effects can combine to alter the biochemical function of the plant in unexpected ways. Reports (Norris et al., 2020; Skryabin et al., 2020; Molteni 2020) describe insertion of the whole plasmid DNA molecules that acted as the recombination template for the SDN-2 or SDN-3 procedure. The insertion of these plasmid DNA templates will invariably result in at least one antibiotic resistance gene being incorporated in the genome, as these are a component of plasmids. This risks the transfer of antibiotic resistance genes to disease-causing bacteria in the environment and more worryingly, in the gut of the consumer, which would compromise medical use of antibiotics.

Norris AL et al (2020). *Nat Biotech* 38(2):163-164.<sup>15</sup>

MEDIA ARTICLE: Molteni M (2020). *WIRED*, 24 July.<sup>16</sup>

Skryabin BV et al. (2020). *Science Advances* 6(7), eaax2941.<sup>17</sup>

Ono R et al (2019). *Communications Biology* 2: 57.<sup>18</sup>

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<sup>12</sup> Tuladhar, Rubina, Yunku Yeu, John Tyler Piazza, Zhen Tan, Jean Rene Clemenceau, Xiaofeng Wu, Quinn Barrett, et al. "CRISPR-Cas9-Based Mutagenesis Frequently Provokes on-Target mRNA Misregulation." *Nature Communications* 10, no. 1 (September 6, 2019): 1–10. <https://www.nature.com/articles/s41467-019-12028-5>

<sup>13</sup> Smits, Arne H., Frederik Ziebell, Gerard Joberty, Nico Zinn, William F. Mueller, Sandra Clauder-Münster, Dirk Eberhard, et al. "Biological Plasticity Rescues Target Activity in CRISPR Knock Outs." *Nature Methods* 16, no. 11 (November 2019): 1087–1093. <https://www.nature.com/articles/s41592-019-0614-5>

<sup>14</sup> Tang, Xu, Guanqing Liu, Jianping Zhou, Qirong Ren, Qi You, Li Tian, Xuhui Xin, et al. "A Large-Scale Whole-Genome Sequencing Analysis Reveals Highly Specific Genome Editing by Both Cas9 and Cpf1 (Cas12a) Nucleases in Rice." *Genome Biology* 19, no. 1 (July 4, 2018): 84. <https://genomebiology.biomedcentral.com/articles/10.1186/s13059-018-1458-5>

<sup>15</sup> Norris, Alexis L., Stella S. Lee, Kevin J. Greenlees, Daniel A. Tadesse, Mayumi F. Miller, and Heather A. Lombardi. "Template Plasmid Integration in Germline Genome-Edited Cattle." *Nature Biotechnology* 38, no. 2 (February 2020): 163–164. <https://www.nature.com/articles/s41587-019-0394-6>

<sup>16</sup> "A Crispr Cow Is Born. It's Definitely a Boy." *Wired*, July 24, 2020. <https://www.wired.com/story/a-crispr-calf-is-born-its-definitely-a-boy/>

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# Seed Freedom



A Global Citizens' Report

Co-ordinated by Navdanya



## **Gates to a Global Empire**

### **...over Seed, Food, Health, Knowledge and The Earth**

A Global Citizens' Report

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