

DRIVEN TO EXTERMINATE: HOW BILL GATES BROUGHT GENE DRIVE EXTINCTION TECHNOLOGY INTO THE WORLD

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In 2016, at the Forbes 400 Summit on Philanthropy in New York, Bill Gates was asked to give his opinion on gene drives, a risky and controversial new technology that could—by design—lead to the complete extermination of the malaria-carrying mosquito species, *Anopheles gambiae*. If it were his decision to wipe out this mosquito once and for all, given the risks and benefits being considered, would he be ready to do it? “I would deploy it two years from now,” he replied confidently. However, he added, “How we get approval is pretty open ended.”

Gates's ‘let’s deploy it’ response may not seem out of character, but it was an unusually gung-ho response given how risky the technology is widely acknowledged to be. Gene drives have been dubbed an “extinction technology” and with good reason: gene drive organisms are created by genetically engineering a living organism with a particular trait, and then modifying the organism’s reproductive system in order to always force the modified gene onto future generations, spreading the trait throughout the entire population.

In the case of the *Anopheles gambiae* project (that Gates bankrolls), a gene drive is designed¹ to interfere with the fertility of the mosquito: essential genes for fertility would be removed, preventing the mosquitoes from having female offspring or from having offspring altogether. These modified mosquitoes would then pass on their genes to a high percentage of their offspring, spreading auto-extinction genes throughout the population. In time, the entire species would in effect be completely eliminated².

Although still new and unproven, gene drives have provoked significant alarm among ecologists, biosafety experts and civil society, many of whom have backed a call for a complete moratorium on the technology. By deliberately harnessing the spread of engineered genes to alter entire populations, gene drives turn on its head the usual imperative to try to contain and prevent engineered genes from contaminating and disrupting ecosystems. The underlying genetic engineering technology is unpredictable and may provoke spread of intended traits. The notion that a species can be removed from an ecosystem without provoking a set of negative impacts on food webs and ecosystem functions is wishful thinking and even taking out a carrier of an unpleasant parasite does not mean the parasite won’t just jump to a different host. Moreover, the implicit power in being able to re-model or delete entire species and ecosystems from the

¹ “Self-Sustaining.” *Target Malaria | Our Work*. <https://targetmalaria.org/our-work/self-sustaining/>

² Dunning, Hayley . “Malaria Mosquitoes Eliminated in Lab by Creating All-Male Populations.” *Imperial College London | News*, May 11, 2020. <https://www.imperial.ac.uk/news/197394/malaria-mosquitoes-eliminated-creating-all-male-populations/>

genetic level up is attracting the interest of militaries and agribusiness alike and runs counter to the idea of working with nature to manage conservation and agriculture.

That Gates is so enthusiastic about releasing this powerful genetic technology is not so surprising when one scratches the surface of the myriad institutions that have been researching and promoting gene drives for years. To date, the Bill and Melinda Gates Foundation (BMGF) is either the first or second largest funder³ of gene drive research (alongside the shadowy U.S. Defense Advanced Research Projects Agency (DARPA) whose exact level of investment is disputed⁴). Gates is not just another tech optimist standing on a business stage calling for gene drive release to be allowed—his foundation has poured millions of dollars into gene drive research for over a decade. Yet direct research funding is not the only way in which the BMGF has accelerated the development of this technology. They have also funded and influenced lobbyists, regulators, and public narratives around gene drives, in an attempt to push this dangerous sci-fi sounding technology into real world use, shifting research priorities on industrial agriculture, conservation and health strategies along the way.

Funding the Research

While the controversy around gene drives is recent, promoters like to emphasize that research towards creating gene drive technology has been in the works for many years. From its inception, much of this research has received direct funding from the BMGF, funneled through different academic institutions. The beginning of current research into genetically modified extinction technology can be traced back to 2003 when Austin Burt, a professor of Evolutionary Genetics at Imperial College in London, was working with yeast enzymes, noting how 'selfish genes' were able to reproduce with a greater probability than the usual 50-50 ratio that occurs in normal sexual reproduction. In a paper, he explained how these genes could be adapted for other uses, such as in mosquitoes, where the destruction of the insects could be embedded directly into their genes. Burt, along with Andrea Crisanti, another biologist at Imperial College, applied for a US\$8.5 million grant from the Bill and Melinda Gates Foundation (which they received in 2005) to take forward their theories and apply them in a lab, eventually creating an international project called 'Target Malaria'. In an interview with *Wired* magazine⁵, Crisanti explained how this funding and the relationship with the BMGF was instrumental in the further development of gene drives technology. "If you need a resource, you get it, if you need a technology, you get it, if you need equipment, you get it. We were left with the notion that success is only up to us," he said.

³ Regalado, Antonio. "Bill Gates Is Betting Big on a Technology That Could Make Mosquitoes Extinct." *Business Insider | MIT Technology Review*, September 7, 2016. <https://www.businessinsider.com/bill-gates-foundation-gene-drive-kill-mosquitoes-2016-9>

⁴ "Gene Drive Files Expose Leading Role of US Military in Gene Drive Development." *Gene Drive Files | Synbiowatch*. Ref. 3. <http://genedrivefiles.synbiowatch.org/2017/12/01/us-military-gene-drive-development/#3>

⁵ O'Mahony, Jennifer. "Science Moves Closer to Killing Malaria with Mutant Mosquitos." *Wired UK*, n.d. <https://www.wired.co.uk/article/mosquito-gene-drive-malaria>

At the same time, in 2005, the BMGF was also channeling money into the Foundation for the National Institutes of Health (FNIH), as part of a larger US\$436 million grant for a project called the Grand Challenges in Global Health Initiative. Through the FNIH, a biologist at UC Irvine, Anthony James, was injecting DNA into mosquito embryos⁶ to create transgenic mosquitoes resistant to dengue fever. These mosquitoes were able to reproduce which meant that normal mosquito populations could possibly be replaced by GM mosquitoes if only a way could be found to drive the engineered genes into populations. In 2011, James' lab genetically engineered the mosquito species *Anopheles stephensi* with genes that made it resistant to malaria.



All these developments were significant, but they had not yet led to the creation of gene drives. That moment came in 2015, when two scientists at UC San Diego, California, Ethan Bier and Valentino Gantz, created a gene-construct that could spread a trait through fruit flies, turning the entire population yellow. The technology they had developed used a new genetic engineering tool called CRISPR-Cas9 which could cut DNA and enable genes to be inserted, replaced or deleted from DNA sequences⁷. In effect Gantz and Bier built the genetic engineering tool directly into the flies' genome so each generation genetically engineered its offspring. CRISPR-Cas9 technology was instrumental in the creation of the gene drive and in late 2015, functional gene drive modified mosquitoes

⁶ University of California - Irvine. "Genetically Engineered Mosquitoes Show Resistance To Dengue Fever Virus." *ScienceDaily*, March 10, 2006.

<https://www.sciencedaily.com/releases/2006/03/060308213147.htm>

⁷ Esvelt KM, Smidler AL, Catteruccia F, Church GM. Concerning RNA-guided gene drives for the alteration of wild populations. *Elife*. 2014;3 pii:e03401 10.7554/eLife.0340.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4117217/>

were created. This is what the Gates Foundation was waiting for. In 2016, an official with the Gates Foundation said in an interview that malaria could not be wiped out without a gene drive; all of a sudden this 'extinction technology' was considered not just desirable, but "necessary" in the fight to end malaria.

Since then, the push for further research and deployment of gene drives has gained considerable momentum—mostly propelled by Gates dollars. The BMGF has funneled even more funding into taking gene drive research forward. In 2017, UC Irvine received another US\$2 million directly from the BMGF for Anthony James to genetically engineer the malaria-carrying mosquito species *Anopheles gambiae*, with a view to eventually releasing them in a trial⁸. Meanwhile, Target Malaria, the flagship research consortium that came from Burt and Crisanti's work, has received US\$75 million from the foundation⁹. This has been used to create labs in Burkina Faso, Mali and Uganda in order to begin experimenting with gene drives in Africa, and in 2019 Target Malaria released 4,000 genetically modified (not gene drive) mosquitoes in Burkina Faso as a first step in their experiment. Their goal is to release the gene drive mosquitoes in Burkina Faso in 2024. BMGF has also bankrolled further gene drive research in Siena Italy, Jerusalem, Israel and Boston, USA¹⁰.

Synthetic Biology and Agricultural Interests

Although mainstream media coverage of gene drive developments emphasizes Gates's grandiose philanthropic intentions in eliminating malaria and saving lives in Africa, there is more than meets the eye when it comes to Gates's direct funding of gene drive research.

Gene drives are classified as part of a controversial field of extreme genetic engineering known as synthetic biology (synbio) or 'GMO 2.0' in which living organisms can be redesigned in the lab to have new abilities¹¹. Synthetic Biology aims to redesign and fabricate biological components and systems that do not exist in the natural world¹². Today it is a multi-billion-dollar industry which creates compounds like synthetic ingredients (synthetic versions of saffron, vanilla etc), medicines and lab-grown food products. Gates's ambitions for this radical biotech field extend beyond gene drives and malaria research and into the field of synbio. In an interview, he said that if he were a teenager today, he would be hacking biology: "If you want to change the world in some big way, that's where you

⁸ Perkes, Courtney . "UCI Mosquito Project Receives \$2 Million from Gates Foundation to Fight Malaria." *Orange County Register*, May 10, 2017. <https://www.ocregister.com/2017/05/09/uci-mosquito-project-receives-2-million-from-gates-foundation-to-fight-malaria/>

⁹ Kotecki, Peter. "Mosquito-Borne Diseases Kill Millions of People Each Year. A Team of Scientists Think Genetic Manipulation Could Wipe out the Worst of Them." *Business Insider*, January 16, 2019. <https://www.businessinsider.com/target-malaria-wants-to-end-mosquito-borne-disease-using-gene-drives-2019-1>

¹⁰ "Search Results 'Gene Drive.'" *Bill & Melinda Gates Foundation*. <https://www.gatesfoundation.org/search#q/k=%22gene%20drive%22>

¹¹ Thomas, Jim. "What Is Synthetic Biology?" ETC Group, n.d. https://www.etcgroup.org/sites/www.etcgroup.org/files/files/synbio_comics-complete_letter_size_rev.pdf

¹² "Synthetic Biology Explained." *Biotechnology Innovation Organization*. <https://www.bio.org/articles/synthetic-biology-explained>

should start—biological molecules.”¹³

The Gates Foundation has had a substantial influence on the synthetic biology industry since its inception. In 2005, when the field was still relatively new, the BMGF gave a grant of US\$42.5 million (and later more) to the University of California Berkeley and Amyris, a startup synbio company, in order to produce the antimalarial drug artemisinin in a laboratory with genetically engineered microbes¹⁴. The aim of this grant was not only to create the antimalarial drug, but also to create new biofuels, medicines and high value chemicals. The founder of Amyris, Jay Keasling, has told ETC Group that the Gates funds were contingent on finding other more profitable lines of business in addition to artemisinin and so initially the technology was simultaneously applied to biofuel production. Jack Newman, a scientist at Amyris explained that “the very same pathways” used in artemisinin “can be used for anticancer (drugs), antivirals, antioxidants.”¹⁵

While using philanthropic funds to bankroll a private biofuel business might seem ethically questionable, the supposedly beneficial target of making an antimalarial molecule may not have been so positive either. In 2013, after many years of research by the UC Berkeley Laboratory and Amyris, it was announced that the French pharmaceutical company, Sanofi, would launch the production of synthetic artemisinin¹⁶. Commercial production of the compound was hailed as more affordable than naturally grown artemisinin, which is farmed in countries like Kenya, Tanzania, Madagascar, Mozambique, India, Vietnam and China. However, what was not mentioned during all the hype around the synthetic production of the compound was that artemisinin farmers in these countries would lose their livelihoods as a result of the sale of the synbio version¹⁷. In the hype and supported by philanthropic money, prices for artemisinin crashed and some natural artemisinin extractors were shuttered. Eventually, even the synthetic product proved too expensive to sell¹⁸.

The BMGF investments' in syn bio go further still. The Foundation invested in a number of other synbio companies including Editas Medicine, a genome editing company that controls the CRISPR-Cas9 technology behind gene drives, and Ginkgo Bioworks, which creates microbes for application in fashion, medicine and

¹³ Levy, Steven. “Geek Power: Steven Levy Revisits Tech Titans, Hackers, Idealists.” *Wired*, April 19, 2010. https://www.wired.com/2010/04/ff_hackers/5/

¹⁴ Kanellos, Michael. “Gates Foundation to Promote Synthetic Biology.” *CNET*. Last modified November 12, 2005. <https://www.cnet.com/news/gates-foundation-to-promote-synthetic-biology/>

¹⁵ Kanellos, Michael. “Gates Foundation to Promote Synthetic Biology.” *ZDNet*. Last modified November 18, 2005. <https://www.zdnet.com/article/gates-foundation-to-promote-synthetic-biology/>

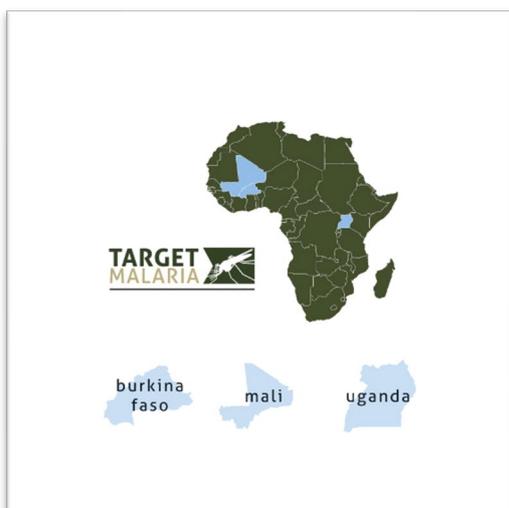
¹⁶ Sanders, Robert. “Launch of Antimalarial Drug a Triumph for UC Berkeley, Synthetic Biology.” *Berkeley News*, April 11, 2013. <https://news.berkeley.edu/2013/04/11/launch-of-antimalarial-drug-a-triumph-for-uc-berkeley-synthetic-biology/>

¹⁷ Thomas, Jim. “Synthetic Anti-Malaria Compound Is Bad News for Artemisia Farmers | Jim Thomas.” *The Guardian*, April 12, 2013. <http://www.theguardian.com/global-development/poverty-matters/2013/apr/12/synthetic-malaria-compound-artemisia-farmers>

¹⁸ Peplow, Mark. “Synthetic Biology’s First Malaria Drug Meets Market Resistance.” *Nature News* 530, no. 7591 (February 23, 2016): 389. <https://www.nature.com/news/synthetic-biology-s-first-malaria-drug-meets-market-resistance-1.19426>

industry¹⁹. Gates is also keen on the so-called “cellular food revolution” which grows food from cells in a lab. His investments in the sector include Memphis Meat, a company that creates cell-based meat without animals, Pivot Bio, which creates engineered microbes for use in agriculture, and Impossible Foods, which makes processed meat-like burgers from a synthetic biology-derived blood substitute.

That Gates is pouring so much money into an industry that is oriented toward shifting agriculture and the food systems toward hi-tech approaches is no accident, given how influential the Foundation is in global health and agriculture policy generally, and in promoting industrial agriculture in the global South and



especially Africa. In the case of gene drives, while most international debate has focused on their application in malaria and conservation, the industrial farm is where gene drives may first make their impact²⁰; the very foundational patents for gene drives have been written with agricultural applications in mind. In 2017, a secretive group of military advisors known as the JASON Group produced a classified study on gene drives commissioned by the US government which was tasked to address “what might be realizable in the next 3-10 years, especially with regard to agricultural applications.” The JASON Group was also

informed by gene drive researchers who were present during a presentation on crop science and gene drives delivered by someone from Bayer-Monsanto. Other groups involved in gene drive discussions behind the scene include Cibus, an agricultural biotech firm, as well as agribusiness majors including Syngenta and Corteva Agriscience.

The startup Agragene, whose co-founders are none other than the gene drive researchers Ethan Bier and Valentino Gantz of University of California at San Diego, “intends to alter plants and insects” using gene drives. The JASON Group and others have also raised the flag that gene drives have biowarfare potential—in part explaining the strong interest of US and other militaries in the technology.

Shaping the Narrative Around Gene Drives

Not only has the Gates Foundation funded the underlying tools of the synbio industry and moulded gene drive research for years, it has also been quietly working behind the scenes to influence the adoption of these risky technologies. The way in which policy and public relations about gene drives research has been shaped by the Foundation becomes clear when one examines what happened

¹⁹ Cumbers, John. “Meet Eight Tech Titans Investing In Synthetic Biology.” *Forbes*. Last modified September 14, 2019. <https://www.forbes.com/sites/johncumbers/2019/09/14/meet-the-8-tech-titans-investing-in-synthetic-biology/>

²⁰ ETC Group. “Forcing the Farm,” October 2018.

https://www.etcgroup.org/sites/www.etcgroup.org/files/files/etc_hbf_forcing_the_farm_web.pdf

immediately after the creation of the first functional gene drives with CRISPR Cas9 technology in late 2014.

In early 2015, the US National Academies of Science, Engineering and Medicine announced that they would have a major inquiry into gene drives—an unprecedented move for such a brand new (only months old) technology. The study did not explore just the science of gene drives, but also aimed to frame issues around policy, ethics, risk assessment, governance and public engagement around gene drives²¹. It was sponsored by the Defense Advanced Research Projects Agency (DARPA) and The Bill & Melinda Gates Foundation, through the National Institutes of Health (NIH) and the Foundation for the National Institutes of Health (FNIH). Several panel members were recipients of Gates funds.



Source: ETC Group²²

The Foundation has also channeled money into the MIT media lab, home to Kevin Esvelt, who directs a group called Sculpting Evolution and was among the first people to identify the potential of CRISPR-based gene drive to alter wild populations²³. Last year the MIT Media Lab was embroiled in a controversy when it was revealed that it had received donations from the convicted sex offender

²¹ National Academies of Sciences, Engineering, and Medicine. (2016). *Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values*. The National Academies Press. <https://doi.org/10.17226/23405>

²² "Over 200 Global Food Movement Leaders and Organizations Reject 'Gene Drives.'" *ETC Group*, October 16, 2018. <https://www.etcgroup.org/content/over-200-global-food-movement-leaders-and-organizations-reject-gene-drives>

²³ "Person Overview | Kevin Esvelt." *MIT Media Lab*. <https://www.media.mit.edu/people/esvelt/overview/>

Jeffrey Epstein. Through Epstein, the media lab secured US\$2 million from Gates although it is not clear for which project²⁴.

One of the most controversial findings which illustrate the extent to which the Gates Foundation is invested in influencing the uptake of gene drive technology was made in 2017 by civil society organizations following a Freedom of Information request. That process led to the release of a trove of emails revealing that a private PR firm called Emerging Ag, was paid US\$1.6 million by the BMGF²⁵. Part of their work involved coordinating the “fight back against gene drive moratorium proponents,” as well as running a covert advocacy coalition to exert influence on the United Nations Convention on Biological Diversity (CBD), the key body for gene drive governance. After calls in 2016 for a global moratorium on the use of gene drive technology, the CBD sought input from scientists and experts in an online forum²⁶. Emerging Ag recruited and coordinated over 65 experts, including a Gates Foundation senior official, a DARPA (Defense Advanced Research Project Agency) official, and government and university scientists, in an attempt to flood the official UN process with their coordinated inputs.

Emerging Ag Inc. ²⁷	2020	Malaria	Global Health	\$2,509,762
Emerging Ag Inc. ²⁸	2017	Malaria	Global Health	\$1,603,405

Source: Bill and Melinda Gates Foundation²⁹

Emerging Ag now manages an overt advocacy network also funded by the BMGF called the Outreach Network for Gene Drive Research whose stated intention is to “raise awareness of the value of gene drive research for the public

²⁴ Farrow, Ronan. “How an Élite University Research Center Concealed Its Relationship with Jeffrey Epstein.” *The New Yorker*. Last modified September 7, 2019.

<https://www.newyorker.com/news/news-desk/how-an-elite-university-research-center-concealed-its-relationship-with-jeffrey-epstein>

²⁵ “Gates Foundation Paid PR Firm to Secretly Stack UN Expert Process on Controversial Extinction Technology.” *Gene Drive Files | Synbiowatch*, December 1, 2017.

http://genedrivefiles.synbiowatch.org/2017/12/01/gates_foundation_pr/

²⁶ “160 Global Groups Call for Moratorium on New Genetic Extinction Technology at UN Convention.” *SynBioWatch*. Last modified December 5, 2016.

<http://www.synbiowatch.org/2016/12/160-global-groups-call-for-moratorium-on-new-genetic-extinction-technology-at-un-convention/>

²⁷ “INV-005523 - Emerging Ag Inc.” *Bill & Melinda Gates Foundation | How We Work | Grant*. <https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2020/05/INV-005523>

²⁸ “Emerging Ag Inc. - OPP1174273.” *Bill & Melinda Gates Foundation | How We Work | Grant*. <https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2017/07/OPP1174273>

²⁹ “Search Results: ‘Emerging Ag Inc Gene Drive.’” *Bill & Melinda Gates Foundation | How We Work | Grantmaking | Awarded Grants*. <https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database#q/k=emerging%20ag%20inc%20gene%20drive>

good."³⁰ Its members include researchers and organizations that work on gene drive research, stakeholder engagement, outreach and even funders. Almost all of its members are separately funded by the Gates Foundation. In 2020, Emerging Ag received another grant from the Foundation for \$2,509,762.

Governance and Lobbying at International Fora

During the international negotiations of the Convention on Biological Diversity (CBD) COP14 in Sharm el Sheikh in 2018, the influence of the Gates machinery was on clear display. The multiple initiatives in which the Foundation had invested beforehand ended up having important consequences. Not only had the Foundation sought to influence the expert panels that inform the Convention before the actual negotiations took place, but they had also managed to ensure that political support for gene drives in Africa, where the first gene drive mosquitoes are due to be released, was established well before the official negotiations, countering civil society concerns about and resistance to this highly risky technology.

About six months prior to COP14, the African Union's technical arm, the New Partnership for Africa's Development (NEPAD) released a report in support of gene drive mosquitoes for malaria eradication. A year prior to the report, NEPAD was awarded \$2,350,000 from the Open Philanthropy Project, a major co-funder of Target Malaria alongside BMGF, to support the evaluation, preparation and possible deployment of gene drives. Open Philanthropy's funding priorities often move in lockstep with BMGF priorities and they are part of the same 'effective altruism' movement of technocratic billionaires. Additionally, a new crop of African negotiators, new to the CBD, arrived at the Sharm-el-Sheikh negotiations vocally arguing in favour of gene drives. Many of this new cohort were drawn from ABNE, the African Network on Biosafety Expertise—a Gates funded biotech policy network on the African continent that is at the heart of BGMF influence on African biotech policy. It was no surprise then when, at the CBD, the consensus position of the African group of delegates was one that was in favour of gene drives, and they blocked a moratorium on the release of gene drive organisms which was requested by African civil society groups³¹.

So embedded were the individuals from institutions funded by the BMGF in the official negotiations that even certain people serving as official government delegates were found to have been paid or employed by Target Malaria. On the sidelines lobbyists from other Gates funded outfits, such as The Cornell Alliance for Science also railed against the moratorium proposal³².

From bankrolling the technology development and creating the underlying tools, to shaping the narrative, picking the policy negotiators and even paying the

³⁰ "About." *Outreach Network for Gene Drive Research*. <https://genedrivenetwork.org/#about>

³¹ "Do Not Betray Africa on SynBio and Gene Drives." *ETC Group*. Last modified November 19, 2018. <https://www.etcgroup.org/content/do-not-betray-africa-synbio-and-gene-drives>

³² Gakpo, Joseph Opoku . "Africa Kicks against Proposed Gene Drive Moratorium at UN Biodiversity Conference." *Alliance for Science*, November 20, 2018. <https://allianceforscience.cornell.edu/blog/2018/11/africa-kicks-proposed-gene-drive-moratorium-un-biodiversity-conference/>

lobbyists, Bill Gates and his Foundation have so far been tightly interwoven into every part of the story of gene drive extinction technology. However, although the Foundation has been highly successful in influencing the technology's future deployment, they have not been able to suppress the global movements which have sprung up in resistance to gene drive technology. And just as health activists and food sovereignty activists have pushed back against the white saviour complex of philanthro-capitalists, so movements in West Africa have been quick to point out the racism and injustice of Gates-backed groups such as Target Malaria, who are using African people and ecosystems as experimental subjects for gene drive technology. In June 2018, over 1,000 farmers and activists protested against gene drive technology in the streets of Ouagadougou. Many are concerned about the eventual agricultural applications of gene drives and in the case of malaria, they believe that indigenous medicine and existing methods are better suited to fight the disease, particularly given the increasing number of countries which have completely eradicated it³³. In the words of food sovereignty activist Ali Tapsoba, with the organization Terre à Vie, "The best way to fight against malaria remains to put in place a good sanitation policy for our habitats and our environment. It is out of the question for us to let these scientists continue to conduct dangerous experiments outside their laboratories." It is perhaps at its intended point of experimentation, in Burkina Faso, that the Gates machinery will finally be forced to grind to a halt.



Protest in Burkina Faso, June 2018. Photo: Terre à Vie

³³ Brown, Evan Nicole. "How Algeria and Argentina Became Officially Malaria-Free." *Atlas Obscura*. Last modified May 30, 2019. <http://www.atlasobscura.com/articles/algeria-argentina-malaria-free>