

THE COMPLEX CHOREOGRAPHY OF AGRICULTURAL BIOTECHNOLOGY IN AFRICA

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ABSTRACT

In spite of impressive efforts from public and private organizations over the last 25 years, agricultural biotechnology has gained relatively little ground in Africa. Using ethnographic research and case studies from across the continent, we argue that a complex choreography of socio-political, regulatory, and business conditions is required for agricultural biotechnology projects to ‘succeed’ in Africa. While this choreography is rarely achieved, efforts to bring agricultural biotechnology to the continent have resulted in significant reconfigurations of political, legal, and media landscapes in many African countries. These shifts cry out for more scholarly attention, which we attempt to give here.

IN A 2004 ARTICLE ENTITLED, ‘What’s the Holdup? Addressing constraints to the use of plant biotechnology in developing countries’, Lawrence Kent, then Director of International Programs at the Donald Danforth Plant Science Center in St. Louis, argued that a number of barriers were keeping genetically modified (GM) seeds from the world’s poorest. These challenges included a lack of locale-appropriate seeds, and lack of institutional support in the form of biosafety and plant patent laws.¹ In the years since, both private and public sector actors have followed Kent’s blueprint to work tirelessly to bring agricultural biotechnology to the African continent. Together, some of the world’s largest development

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1 Lawrence Kent, ‘What’s the holdup? Addressing constraints to the use of plant biotechnology in developing countries’, *AgBioForum* 7, 1&2 (2004), pp. 63–69.

donors including the Bill & Melinda Gates Foundation, the US Agency for International Development (USAID) and the Rockefeller Foundation have established partnerships with private industry to develop GM crops for Africa,² spent millions of dollars on capacity building around biotechnology regulation and safety assessment in particular African countries,³ worked to mobilize constituencies to support agricultural biotechnology,⁴ cultivated local partners with scientific knowledge and political skills who could help shepherd products through the regulatory process,⁵ and tried to create a more welcoming policy environment for the development and delivery of GM crops.⁶

Yet, despite these efforts, at the time of writing, only seven African countries (Burkina Faso, Nigeria, South Africa, Sudan, Zambia, and Swaziland) have approved any GM crops and most of these have approved only one, most commonly, insect resistant cotton. Moreover, of these countries, only South Africa and Nigeria have embraced agricultural biotechnology in a significant way. Why has there been so little forward movement towards a biotech future on the continent? Put more starkly, why have the strategic and well-funded efforts to ensure that Africans would no longer be ‘starved for science’, as political scientist Robert Paarlberg so provocatively put it, yielded so little?⁷

One answer to this question, typically advanced by those who are highly supportive of these crops, is that anti-GM activism is the primary obstacle.⁸ According to some scholars, the greatest blame falls on ‘well fed’ activists from European and other advanced industrialized countries, who hypocritically reject the very same agricultural sciences that ensured

2 See, for example, ‘Water Efficient Maize for Africa’, *CIMMYT*, <<https://www.cimmyt.org/projects/water-efficient-maize-for-africa-wema/>> (3 November 2019).

3 Examples include USAID’s Agricultural Biotechnology Support Project and Program for Biosafety Systems (described below) and the Gates Foundation funded African Biosafety Network of Expertise. See: ‘African Biosafety Network of Experts’, Michigan State University, <<https://www.canr.msu.edu/global/projects/african-biosafety-network/>> (3 November 2019).

4 Matthew Harsh, ‘Nongovernmental organizations and genetically modified crops in Kenya: Understanding influence within a techno-civil society’, *Geoforum* 53 (2014), pp. 172–83; Matthew Schnurr, ‘Biotechnology and bio-hegemony in Uganda: unraveling the social relations underpinning the promotion of genetically modified crops into new African markets’, *The Journal of Peasant Studies* 40, 4 (2013), pp. 639–58; Matthew Schnurr and Christopher Gore, ‘Getting to “Yes”: Governing genetically modified crops in Uganda’, *Journal of International Development* 27, 1 (2015), pp. 55–72.

5 Joeva Rock, *We are not starving: GMOs and Ghanaian food sovereignty advocacy in the age of the African Green Revolution* (American University, unpublished PhD dissertation, 2018); Schnurr and Gore, ‘Getting to “Yes”’.

6 Schnurr, ‘Biotechnology and bio-hegemony in Uganda’.

7 Robert L. Paarlberg, *Starved for science: How biotechnology is being kept out of Africa* (Harvard University Press, Cambridge, 2009).

8 AATF-OFAB, ‘*The Open Forum on Agricultural Biotechnology (OFAB): A decade of success, 2006–2016*’, (African Agricultural Technology Foundation, Nairobi, 2017); Mark Lynas, ‘Confession of an anti-GMO activist’, *Wall Street Journal*, 2018, <<https://www.wsj.com/articles/confession-of-an-anti-gmo-activist-1529679465>> (14 May 2019).

that they would have enough to eat.⁹ Other authors argue that anti-GM activists have spread lies, myths, and misinformation about the technology, preposterously exaggerating the risks of GM crops while ignoring their benefits.¹⁰ These supposed falsehoods have led African governments to be overly wary of biotechnology, making it difficult to pass legislation permitting its introduction and dissemination. The result has been a regulatory paralysis that makes it impossible to move forward.

Another body of scholarship, rooted in a political economy perspective, tends to overlook the fact that after 30 years, GM crops have gained relatively little ground in Africa. This literature focuses instead on the powerful corporations involved in producing and selling GM crops, the supportive practices of aid donors and philanthropists, and GM crop adoption patterns. Some of these critically minded scholars call attention to the problematic merger of ‘biocapital’ and ‘philanthrocapital’ and see the collective efforts of firms, donors, and biotech advocacy groups as an attempt to establish ‘bio-hegemony’ on the continent.¹¹

In this paper, we offer an alternative explanation as to why biotechnology has not spread rapidly across Africa, as advocates have desired and critics have feared. Rather than focus on singular explanations, we argue that a wide array of conditions need to be in place for agricultural biotechnology to take hold. As we demonstrate here, a perfectly timed and difficult-to-achieve choreography of political, socio-political, regulatory, techno-scientific, and business conditions is required for agricultural biotechnology to ‘succeed’ in Africa. If these conditions are not met, and not met simultaneously, biotechnology projects do not move forward.

In making the argument that biotechnology projects depend on a complex choreography, we urge scholars who focus their attention mainly on activists to recognize that decisions by many actors, from biotech firms to aid donors to policymakers to farmers, also represent obstacles or sources of resistance at different moments. Activism matters, but it is not the sole reason why GM crops have not spread across the continent or been the panacea for smallholder farmers that many suggested they would be. To those writing from a political economy perspective—a literature on which we ourselves build—our analysis reveals the multiple sources of agency at play and the indeterminacy of outcomes associated with the technology. It

9 Robert Paarlberg, *Starved for science*.

10 AATF-OFAB, ‘OFAB: A decade of success’.

11 Jacqueline A. Ignatova, ‘The “philanthropic” gene: Biocapital and the new Green Revolution in Africa’, *Third World Quarterly* 38, 10 (2017), pp. 2258–75; Schnurr, ‘Biotechnology and bio-hegemony’; Schnurr and Gore, ‘Getting to “Yes”’; Carol Thompson, ‘Philanthrocapitalism: appropriation of Africa’s genetic wealth’, *Review of African Political Economy* 41, 141 (2014), pp. 389–405.

also offers a strong reminder of the need to analyse biotechnology in context and on a case-by-case basis.¹²

To support our argument, we draw from existing literature on several African countries' experiences with GM crops and present three vignettes that capture the situation of agricultural biotechnology as it has unfolded in Ghana. Ghana is a useful case both because it reveals the diverse challenges associated with introducing GM crops and because it would seem to offer such a propitious environment for biotechnology. Not only does Ghana have robust scientific institutions and a large assemblage of scientists who are capable of working with these techniques, but the government has been deeply committed to modernizing the agricultural sector prior to and since achieving political independence in 1957.¹³ Ghana also has an excellent reputation and relationship with donors, who widely consider it a development success story.¹⁴

The data upon which we rely derive from three main sources. First, our analysis on continental trends comes from a review of publicly available materials, mainly academic research as well as documents and webpages from various organizations and media sources. Second, data on Ghana was gathered by Rock, who completed 15 months of ethnographic fieldwork in Ghana between 2014 and 2019, which included over 70 semi-structured with Ghanaian scientists, activists, farmers, and officials. Finally, interviews with eight staff and board members of the African Agricultural Technology Foundation (AATF) was collected by Schurman during fieldwork in Kenya in 2013; this was supplemented with interviews with Rockefeller Foundation staff and Meridian Institute staff conducted between 2012 and 2015.¹⁵

Our analysis proceeds as follows. In the following section, we briefly examine the political economy scholarship that has analysed biotechnology in Africa and upon which this article builds. This work identifies the actors involved in agricultural biotechnology and the current situation. In section three, we turn to our Ghana vignettes to show how a complex choreography

12 On the importance of studying biotechnology in context, see Matthew Harsh and James Smith, 'Technology, governance and place: Situating biotechnology in Kenya,' *Science and Public Policy* 34, 4 (2007), pp. 251–260; Matthew A. Schnurr, 'Inventing Makhathini: Creating a prototype for the dissemination of genetically modified crops into Africa,' *Geoforum* 43 (2012), pp. 784–792.

13 Kojo Sebastian Amanor, 'From farmer participation to pro-poor seed markets: The political economy of commercial cereal seed networks in Ghana,' *IDS Bulletin* 42, 4 (2011), pp. 48–58; Hanson Nyantakyi-Frimpong and Rachel Bezner Kerr, 'A political ecology of high-input agriculture in northern Ghana,' *African Geographical Review* 34, 1 (2015), pp. 13–35.

14 Joeva Rock, '"We are not starving": Challenging genetically modified seeds and development in Ghana,' *Culture, Agriculture, Food and Environment* 41, 1 (2019), pp. 15–23.

15 These interviews took place in New York City, Washington, DC, Minneapolis, MN and Des Moines, Iowa at the annual World Food Prize meetings.

unfolds around each project within a specific location, and how distinct dimensions of that choreography have inhibited biotechnology projects from proceeding. In particular, our vignettes highlight the significance of multinational firms' economic interests and their insistence on intellectual property protection, the vulnerabilities that accompany African countries' dependence on external actors for technical support and funding, and the influence of anti-GM activism in a post-colonialism context. Taken together, these vignettes call attention to a wide range of factors that must be in place for agricultural biotechnology projects to succeed in Africa.

While this complex choreography, at least in the case of Ghana, is getting in the way of agricultural biotechnology projects reaching a commercial phase, this does not mean that the efforts being made to promote agricultural biotechnology are inconsequential. Instead, we join other scholars in making the case that the concerted efforts to introduce and promote biotechnology—and indeed, agricultural modernisation more generally—are altering political institutions in a number of countries. We discuss some of these political and institutional reconfigurations in section four, and suggest that it is these, as much as the acceptance or rejection of any particular crop technologies, that should concern us going forward. As we show throughout the article, the kinds of changes promoted by these strong advocates of agricultural biotechnology have set the stage for large, multinational firms to be able to operate in Africa as technology-development partners and on a commercial basis.¹⁶ We expect that these interventions will have significant impacts on countries' agrarian structures, the fate of smallholders, and African farmers' sources of seed, all of which matter tremendously to the future of food in/security and food sovereignty on the continent. The final section comprises our conclusion.

The political economy of agricultural biotechnology

Virtually as soon as recombinant DNA was discovered in the late 1970s, political economy-oriented scholars began studying the new 'bio-revolution' and its implications for the global South in general and for Africa, in particular. One of the central foci of this early research was on the actors involved in developing and promoting the new biotechnologies. Although universities had been the initial sites of biotechnology development, scholars writing at the time noted that a group of large multinational corporations (MNCs), mainly from the

16 Scoones and Glover made a similar argument a decade ago. Since that article was published, USAID, the Gates and Rockefeller Foundations and others have stepped up their activities, creating new institutions and building stronger relationships with African partners. See Ian Scoones and Dominic Glover, 'Africa's biotechnology battle', *Nature* 460 (2009), pp. 797–8.

agrochemical and pharmaceutical industries, was investing heavily in the new biosciences of genetics, molecular biology, and biochemistry, either by partnering with universities or hiring away their scientists to build a new 'life sciences' industry.¹⁷ Frederick Buttel and his colleagues observed that within a few short years, these firms were 'becoming the principal force' in biotechnology research, leading the science to become increasingly privatized and subject to the interests of large MNCs.¹⁸

In analysing the strategies embraced by these large corporations, the early literature emphasized two key trends. One was that these firms were rapidly buying up seed companies to take advantage of the 'increasingly evident synergies among biotechnology, seeds and agrichemicals'.¹⁹ This was leading to concentration in the seed industry, which was worrying for a number of reasons, not least because it represented the deepening of control over the world's seed supply by a handful of 'gene giants'.²⁰ While activists often cast these companies' behavior as being driven by greed, Jack Kloppenburg Jr., and Kate Meagher, among others, interpreted their actions in terms of the broader logic of capitalist competition and accumulation.²¹ A second trend identified by scholars was the fact that the biotech industry was focusing on the two crops grown on millions of acres in the US Midwest (corn and soy), and on two particular engineered traits associated with those crops: herbicide tolerance and insect resistance. The former worked in conjunction with these firms' proprietary agrochemicals, such as Monsanto's RoundUp® and Bayer CropScience's LibertyLink®, while the latter employed a natural bacterium-based pesticide used by the organic industry (*Bacillus thuringiensis*, or Bt) to ward off pests.²² While the development of such traits promised the largest payback in terms of

- 17 Frederick Buttel, Martin Kenney, and Jack Kloppenburg Jr., 'From Green Revolution to biorevolution: Some observations on the changing technological bases of economic transformation in the third world,' *Economic Development and Cultural Change* 34, 1 (1985): pp. 31–55; Calestous Juma, *The gene hunters: biotechnology and the scramble for seeds* (Zed, London, 1989); Martin Kenney, *Biotechnology: The university-industrial complex*. (Yale University Press, New Haven, 1986).
- 18 Frederick Buttel, Martin Kenney, and Jack Kloppenburg Jr., 'Biotechnology and the third world: Toward a global political-economic perspective,' *Politics and the Life Sciences* 2, 2 (1984), pp. 151–187, p. 162; Juma, *The gene hunters*.
- 19 Buttel, Kenney and Kloppenburg Jr., 'From Green Revolution to biorevolution', p. 37. See also Juma, *The gene hunters*, Ch. 4, and Henk Hobbelink, *Biotechnology and the future of world agriculture* (Zed Books, London, 1991).
- 20 Buttel, Kenney and Kloppenburg Jr., 'From Green Revolution to biorevolution'. This term was coined by Pat Mooney of the Rural Advancement Foundation International.
- 21 Kate Meagher, 'Institutionalising the bio-revolution: Implications for Nigerian small-holders,' *Journal of Peasant Studies* 18, 1 (1990), pp. 68–89; Jack Kloppenburg Jr., *First the seed: The political economy of plant biotechnology* (Cambridge University Press, Cambridge, 1988).
- 22 Kloppenburg Jr., *First the seed*; Juma, *The gene hunters*.

profits for these companies, they were seen by critically minded observers as offering few benefits for global South agriculture.²³

Concerns about the new legal and institutional regimes that had emerged in concert with agricultural biotechnology and which extended intellectual property rights (IPR) over genetically engineered plants and their component parts were also highlighted by the political economy literature.²⁴ In writing about the implications for the African continent, Meagher identified three particularly disquieting dimensions:

... the privatization of biogenetic property, the privatization of research, and the socialization of plant genetic resources – the latter constituting the only element of biogenetic technology over which Third World countries have some potential for asserting proprietary control.²⁵

With respect to the first, scholars projected that the patenting of seeds and animals would pose a significant threat to most African, Asian, and Latin American farmers, who either would not be able to afford them or could be prosecuted for using them illegally.²⁶ They also criticized the USA and Europe for pressuring global South governments to adopt northern country-type IPR regimes to facilitate global trade in GM crops and create political-institutional environments that would be amenable to the biotechnology companies.²⁷ They saw this as being in the interest of MNCs rather than the interests of global South countries and farmers.

The emergence of a private plant patenting regime also triggered scholars' concerns about how agronomic research in the global South would be affected.²⁸ While the Kenyan science-and-technology scholar, Calestous Juma, looked quite favourably on the possibilities that biotechnology offered, he and others noted that prior to the emergence of this proprietary regime, germplasm and scientific knowledge flowed freely among plant breeders. Under the new regime, however, agricultural researchers would no longer be able to exchange patented material and scientific and technological information without obtaining permission from and presumably paying their new property owners.²⁹ In Meagher's

23 Miguel Altieri and Peter Rosset, 'Ten reasons why biotechnology will not ensure food security, protect the environment, and reduce poverty in the developing world,' *AgBioForum* 2, 3&4 (1999), pp. 155–162. See also Juma, *The gene hunters*; Hobbelink, *Biotechnology*.

24 Kloppenburg Jr., *First the seed*; Juma, *The gene hunters*; Meagher, 'Institutionalising the bio-revolution.'

25 Meagher, 'Institutionalising the bio-revolution', p. 70.

26 Juma, *The gene hunters*; Vandana Shiva, *Monocultures of the mind: Perspectives on biodiversity and biotechnology* (Zed, London, 1993).

27 Meagher, 'Institutionalising the bio-revolution'.

28 Buttel, Kenney and Kloppenburg, 'From Green Revolution to biorevolution'; Juma, *The gene hunters*.

29 Kloppenburg Jr., *First the seed*; Juma, *The gene hunters*.

estimation, 'patent protection for plant biogenetic products...poses a serious threat to Third World plant breeding, which will become dependent on basic research performed and patented in the developed countries'.³⁰

In addition to seeing the biotech majors as inherently expansionist, the literature documented northern government support for the biotechnology industry—support that took the form of conducive regulatory policies as well as concrete efforts to pave the way for biotechnology firms to sell their crops around the world. Susan Wright, Herbert Gottweis, and Sheila Jasanoff all analysed the evolution of biotechnology regulatory policies in the USA, Germany, and Britain, describing how, despite their differences, each of these governments viewed the life sciences industry as an important future driver of their economies.³¹ One early manifestation of the US government's efforts to bring global South countries into the biotech fold was USAID's funding of the Agricultural Biotechnology Support Project (ABSP) in 1991. This program, which ran for over 20 years, sought to help global South governments, including African governments, move in the direction of embracing agricultural biotechnology. As William Munro observed:

[T]he ABSP was designed to operate on two levels. At one level, it provided support for collaborative laboratory and field research on the development of particular crops and traits... At the second level, it supported networking and training opportunities in order to strengthen the institutional and policy environments for biotechnology. These efforts... aimed to harmonize policy frameworks (especially with respect to the protection of IPR and biosafety protocols) across space, and to thicken pro-biotechnology epistemic communities—both across the north/south divide and across the public/private divide—by facilitating and managing the flow of knowledge, some of which was proprietary.³²

In 2003, USAID funded another program, the Program for Biosafety Systems (PBS), with similar goals. According to Matthew Schnurr, PBS was designed to support 'policy development, capacity building, risk assessment, and regulatory approval in order to create an enabling environment to advance the safe use of biotechnology into new markets'.³³ PBS carried out a range of activities, including providing technical support and legal

30 Meagher, 'Institutionalising the bio-revolution', p. 71.

31 Wright, Susan. *Molecular politics: Developing American and British regulatory policy for genetic engineering, 1972–1982* (University of Chicago Press, Chicago, 1994); Herbert Gottweis, *Governing molecules: The discursive politics of genetic engineering in Europe and the United States* (MIT Press, Cambridge, 1998); Sheila Jasanoff, *Designs on nature* (Princeton University Press, Princeton, 2005).

32 William Munro, *United States interests and the biotechnology project*, (Illinois Wesleyan University, unpublished manuscript, 2019, p. 6).

33 Schnurr, 'Biotechnology and bio-hegemony in Uganda', p. 645.

analysis to government agencies, training global South scientists in biosafety protocols, and preparing briefing documents for policymakers and the media.³⁴

USAID was not the only organization that actively sought to bring agricultural biotechnology to the global South, and to Africa, in particular. As the second author has demonstrated, the Rockefeller Foundation worked with several large agricultural biotech companies, a Washington-based consulting firm, and several prominent African scientists to create the AATF in 2001, an organization that was strategically established on the continent to facilitate partnerships between agricultural biotechnology companies and national and international research institutions working on crops for Africa.³⁵ Since its inception, AATF has received hundreds of millions of dollars from the Rockefeller and Gates Foundations, bilateral aid agencies, and private companies, and is extremely active on the continent.³⁶

Indeed, the birth of the AATF represented a new stage in GM crop development for the continent. Together, donors, industry, and African scientists banded together for a common cause: to move agricultural biotechnology onto the fields of the ordinary African farmer. Proponents contend that GM crops will allow African farmers to rapidly increase yields, lessen reliance on chemicals, and improve incomes.³⁷ For instance, citing a series of *ex ante* studies, James Okeno, Jeffrey Wolt, Manjit Misra, and Lulu Rodriguez argue that West African nations stand to earn millions of dollars annually through the growth of *Bt* cotton.³⁸

Key to the renewed effort to bring biotech to the African continent was the development of ‘broker organizations’: entities that donor and other organizations established to carry out specific missions. These organizations carry out trainings for media personnel, work to pass biosafety legislation, and hold workshops for government officials.³⁹ Matthew Harsh suggests these groups occupy localized NGO spaces and therefore ought to

34 ‘2017 program for biosafety systems’, 11 September 2017, *IFPRI*, <<http://outcomestories.ifpri.info/2017/09/11/program-for-biosafety-systems/>> (10 May 2019).

35 See Rachel Schurman, ‘Building an alliance for biotechnology in Africa’, *Journal of Agrarian Change* 17, 3 (2017), pp. 441–58.

36 The Gates Foundation alone has awarded twelve grants worth a total of \$165 million to the AATF since 2008. This figure was calculated from the Gates Foundation grants data accessed from their website on 12 May 2020.

37 Florence Wambugu, ‘Why Africa needs agricultural biotech’, *Nature* 400, 15–16 (1999); Kaiser Jamil, ‘Biotechnology—A solution to hunger?’, *The United Nations Chronicle* 46, 3–4 (2009).

38 James A. Okeno, Jeffrey Wolt, Manjit Misra and Lulu Rodriguez, ‘Africa’s inevitable walk to genetically modified (GM) crops: Opportunities and challenges for commercialization’, *New Biotechnology* 30, 2 (2013), pp. 124–130.

39 Harsh, ‘Nongovernmental organizations and genetically modified crops in Kenya’, p. 180; Rock, *We are not starving*; Schnurr, ‘Biotechnology and bio-hegemony in Uganda’; Schnurr and Gore, ‘Getting to “Yes.”’

be ‘neutral, disseminators of technical information, and ... forums for open debate’.⁴⁰ However, broker organizations such as the Open Forum for Agricultural Biotechnology (OFAB, established by AATF), PBS (established by USAID), and the Cornell Alliance for Science (established through a grant from the Gates Foundation), explicitly aim to make biotech available in Africa. Writing about Uganda, Matthew Schnurr, and Christopher Gore suggest the joint roles of these groups is to ‘get to “yes”’—in other words, to establish the political, institutional, and social momentum to facilitate the public acceptance, commercialization, and use of agricultural biotechnology.⁴¹

One arena in which brokers have been most influential is the creation of biosafety laws. These policies allow for the importation, commercialisation, and production of biotech crops in a country and have been foundational for the AATF and others to experiment with GM crops. But brokers have also attempted to usher in legislation related to plant patents, the type of regulation major agribusiness players require before doing business in a country. Andrew Mushita and Carol Thompson describe patents as ‘biopiracy’,⁴² while Jacqueline Ignatova argues that new IPR policies in Ghana signal a ‘[shift] away from complex customary notions of property towards western neoliberal ideas about ownership’.⁴³ Others, adopting a Gramscian lens, suggest that these efforts are hegemonic. Schnurr, for instance, examines how pro-biotech brokers and institutional arrangements work to create a ‘consensus that supports biotech’, and in turn, how this ‘consensus maintains its position of dominance while remaining largely unquestioned and unchallenged’.⁴⁴

So, what is the status of GM crops in Africa? Despite the efforts detailed above, few biotech projects have successfully transitioned from pipeline to field to date. Today, only a few countries, mainly South Africa and Burkina Faso, have experimented with any sort of major planting of GM crops. And both of these countries have a mixed track record with the technology. Although GM maize is widespread in South Africa, the trajectory of *Bt* cotton in Makhatini Flats, in the KwaZulu-Natal province of South Africa, offers a different perspective.⁴⁵ In this case, smallholder farmers, who are the primary concern of many GM crop advocates, rapidly adopted *Bt* cotton starting in the late 1990s. Spurring them on was Vunisa Cotton, a company that sold them *Bt* cotton seed, offered extension services and

40 Harsh, ‘Nongovernmental organizations,’ p.180.

41 Schnurr and Gore, ‘Getting to “Yes.”’

42 Andrew Mushita and Carol Thompson, *Biopiracy of biodiversity: Global exchanges as enclosure* (Africa World Press, Trenton, 2007).

43 Ignatova, ‘The “philanthropic” gene,’ p. 2270.

44 Schnurr, ‘Biotechnology and bio-hegemony in Uganda,’ p. 640.

45 Matthew A. Schnurr, ‘Inventing Makhathini.’

credit, and bought their cotton crop.⁴⁶ When another firm moved into the region, it destroyed the monopsony that had made Vunisa's business model profitable. When farmers began side-selling to the new company, Vunisa stopped providing them with credit and ultimately went out of business.⁴⁷ While *Bt* cotton is still being grown by large-scale, irrigated farms in Makhathini, smallholder farmers have abandoned this GM variety because of the high cost of seed and the risk of losing the crop due to weather.⁴⁸

Research on Burkina Faso's experience with *Bt* cotton provides another insight into one of the 'hold ups' around agricultural biotechnology.⁴⁹ A few years after *Bt* cotton swept through South Africa, the Burkina Faso cotton industry followed suit, with farmers adopting *Bt* cotton with enthusiasm. Although *Bt* cotton seed was significantly more expensive than traditional seed, it reduced the number and cost of pesticide applications farmers needed and increased yields, making the investment worthwhile.⁵⁰ According to the International Service for the Adoption of Agri-Biotech Applications, by 2013, almost 70 percent of Burkina Faso's cotton plantings were with *Bt* cultivars.⁵¹ Yet within a few growing seasons, it became apparent that the *Bt* cultivars were yielding shorter cotton fibers and had lower ginning ratios, both of which were detrimental to the quality, and hence, market price, of Burkinabé cotton. In 2016, the Burkina cotton industry turned away from *Bt* cotton and back towards non-GM seeds to preserve its reputation as one of the highest quality cotton producers in the world.⁵²

The experiences of South Africa and Burkina Faso should give pause both to those who enthusiastically champion the benefits of GM crops and those who warn of their impending and monopolistic arrival. As we will show below, arguments based on a biohegemonic theoretical foundation tend to render Africans with little agency. Moreover, these sorts of arguments overlook the material and concrete ways in which Africans influence,

46 Schnurr, 'Inventing Makhathini', p. 786; Bhavani Shankar, Richard Bennett, and Steve Morse, 'Output risk aspects of genetically modified crop technology in South Africa', *Economics of Innovation and New Technology* 16, 4 (2007), pp. 277–91; Bhavani Shankar and Colin Thirtle, 'Pesticide productivity and transgenic cotton technology: The South African smallholder', *Journal of Agricultural Economics* 56, 1 (2005), pp. 97–116.

47 Schnurr, 'Inventing Makhathini'.

48 Dominic Glover, 'Exploring the resilience of *Bt* Cotton's "pro-poor success story"'; Schnurr, 'Inventing Makhathini'.

49 Brian Dowd-Urbe and Matthew A. Schnurr, 'Briefing: Burkina Faso's reversal on genetically modified cotton and the implications for Africa', *African Affairs* 115, 458 (2016), pp. 161–72.

50 Brian Dowd-Urbe, 'Engineering yields and inequality? How institutions and agro-ecology shape *Bt* cotton outcomes in Burkina Faso', *Geoforum* 53 (2014), pp. 161–71; Dowd-Urbe and Schnurr, 'Burkina Faso's reversal'.

51 Dowd-Urbe and Schnurr, 'Burkina Faso's reversal', p. 164.

52 *Ibid.*

think about, and act upon GM crop projects across local and global scales.⁵³ For instance, in Uganda, where Schnurr and others rightly highlighted the use of brokers to establish an industry-friendly biosafety bill in hopes of ‘circumvent[ing] ... the rollout of more sympathetic regulatory regimes at the national level’,⁵⁴ the bill remains in limbo at the time of writing. This is largely due to the hesitancy of President Yoweri Museveni to sign the bill into law, ‘citing concerns around patent rights for farmers, preserving the genetic integrity of the indigenous varieties, and sanctions for scientists who violate these regulations’.⁵⁵ Likewise, despite an impressive number of biotech projects in Kenya, the country has maintained a near-complete ban on GM crops since 2011, with the sole exception of *Bt* cotton, which was approved at the end of 2019.⁵⁶

As these examples suggest, biotech projects in Africa are anything but stable. Treating pro-biotech actors as hegemonic or suggesting that Africans uniformly embrace or oppose plant patents overlooks the very real and complex ways people relate to GM seeds and seed patents.⁵⁷ In the following section, we turn to Ghana, a country that biotech proponents initially held high hopes for as a potential leader in biotech crop adoption. However, after almost a decade of experimentation, a majority of Ghana’s biotech projects stand on shaky ground. Like the examples we have just described, the Ghanaian experience demonstrates the fragility and instability of biotechnology in Africa.

Biotechnology in Ghana

Ghana is an agrarian nation for whom the goal of agricultural modernization has characterized agricultural policies since independence (1957). Ghana’s first president and national hero, Kwame Nkrumah, considered the state to be a necessary driver of agricultural change, and directed state funds towards developing plant breeding programs, infrastructure, and extension programs throughout the country. Nkrumah’s efforts were stymied when he was overthrown in a coup in 1966, and in the decades

53 Seife Ayele, ‘The legitimization of GMO governance in Africa’, *Science & Public Policy* 34, 4 (2007), pp. 239–249.

54 Schnurr, ‘Biotechnology and bio-hegemony in Uganda’, p. 647.

55 Matthew Schnurr, *Africa’s gene revolution: Genetically modified crops and the future of African agriculture* (McGill-Queen’s University Press, Montreal, 2019), p. 50.

56 Patrick Vidiya, ‘Cabinet approves commercial farming of GMO cotton’, 19 December 2019, *The Star*, <<https://www.the-star.co.ke/news/2019-12-19-cabinet-approves-commercial-farming-of-gmo-cotton/>> (1 May 2020).

57 Susannah Chapman, ‘To make one’s name famous: Varietal innovation and intellectual property in the Gambia’, *American Ethnologist* 45 (2018), pp. 482–494; and Jessie Luna, ‘Getting out of the dirt: racialized modernity and environmental inequality in the cotton sector of Burkina Faso’, *Environmental Sociology* 4, 2, (2018), pp. 221–234.

and subsequent series of military coups that followed, little progress was made towards Nkrumah's original vision.

However, agriculture remained a bedrock of state-making. In the nearly 30 years of military rule that followed Nkrumah's overthrow, successive governments sought to spark large-scale agricultural changes. In 1972, for instance, acting leader Colonel Ignatius Kutu Acheampong initiated the nationwide program Operation Feed Yourself, which urged both urban and rural families to maintain home gardens and farms. While these efforts provided some gastro-relief for Ghanaians, the project ultimately failed to create widespread and long lasting agricultural change.⁵⁸ A decade later, authoritarian-turned-democratically elected president J.J. Rawlings signed Ghana onto what would be the first of nearly a dozen structural adjustment programs, effectively crippling an already struggling agricultural sector. Price and fertilizer subsidies that had protected Ghanaian farmers from predatory international markets were cut, as were extension services such as tractor hire.⁵⁹

Faced with a predatory global market, changing climate, and gutted state infrastructure, Ghanaian farmers found themselves face to face with another challenge: the international development industry. In the 1980s, chemical fertilizers and high yielding seeds were introduced across the country by development programs, church missions, and others eager to bring US agricultural technologies to Africa. But with great promise came great disappointment. Programs like Sasakawa Global 2000, which distributed high yielding maize and sorghum varieties and chemical inputs on credit, left farmers in debt, wary of loan schemes, and with weaker soils.⁶⁰ Another shortcoming of the program was its focus on labor-intensive, high-yielding crop varieties, which were not always suited for cash-poor African smallholder farmers.⁶¹ Writing on northern Ghana, Hanson Nyantakyi-Frimpong and Rachel Bezner Kerr found farmers returning to conventional seeds after experimenting with hybrid maize, as these hybrids left many with low yields due to lack of water and poorly timed fertilizer application.⁶² Moreover, farmers cited other benefits of non-hybrid maize: stability (known yields), taste, ability to intercrop, and low labor and input costs.⁶³

58 Janet Girdner, Victor Olorunsola, Myrna Froning and Emmanuel Hansen, 'Ghana's agricultural food policy: Operation feed yourself', *Food Policy* 5, 1 (1980), pp. 14–25.

59 Kodwo Ewusi, 'The impact of structural adjustment on the agricultural sector in Ghana' (Institute of Statistical, Social and Economic Research, University of Ghana, Legon, 1989), pp. 26–7; Nyantakyi-Frimpong and Bezner Kerr, 'A political ecology of high-input agriculture in northern Ghana'.

60 Nyantakyi-Frimpong and Bezner Kerr, 'A political ecology of high-input agriculture in northern Ghana'.

61 Amanor, 'From farmer participation to pro-poor seed markets'.

62 Nyantakyi-Frimpong and Bezner Kerr, 'A political ecology of high-input agriculture in northern Ghana'.

63 *Ibid.*

In Rock’s study with farmers in agricultural Ghana, she too found in the Brong-Ahafo region low use and skepticism of high yielding food crop varieties due to failed development schemes.⁶⁴

It is against this background—and collective memory of failed development schemes—that the story of biotechnology in Ghana unfolds. Efforts to bring biotechnology to Ghana started in the early 2000s, and took off in 2011 when, after almost a decade of deliberation, lawmakers passed the Biosafety Act into law. The Biosafety Act established a biosafety regime, allowing for the design, research, and commercialisation of GM crops. By 2015, Ghanaian regulators had approved testing of six biotech crops, all housed within the Council for Scientific and Industrial Research (CSIR), a state research institution.⁶⁵ In Ghana’s early years of experimentation, donors, private partners, and scientists hoped that Ghana would set an example for the rest of the continent to follow. However, after considerable experimentation amidst heated public debate, only two biotech crops remain in play. The rest have either been abandoned or suspended indefinitely (see Table 1).

Table 1 Biotech crops in Ghana, past and present

Crop (variety if known)	Trait(s)	Funder/facilitator	Technology Partner	Status
Sweet potato	High protein	Tuskegee University	Unknown	Ended due to lack of funding ¹⁰³
<i>Bt</i> cotton (Bollgard II)	Insect resistance	Monsanto	Monsanto	Ended due to exit of funder/ technology partner
<i>Bt</i> cotton	Insect resistance + herbicide tolerance	Monsanto	Monsanto	Ended due to exit of funder/ technology partner
<i>Bt</i> cowpea (Songotra)	Maruca resistant (cry1Ab) ¹⁰⁴	AATF	Monsanto	Confined field trials
NUE rice (NERICA4)	Nitrogen use efficiency	AATF	Arcadia Bio-sciences	Confined field trials
NEWEST rice (NERICA4)	Nitrogen use efficiency; water efficiency; salt tolerance	AATF	Arcadia Bio-sciences	Suspended due to lack of funding

Source: Table constructed by authors.

64 Rock, *We are not starving*.

65 USDA Foreign Agricultural Service, ‘Agricultural biotechnology annual report’ (Global Agricultural Information Network, 2015).

There are two types of biotech projects in Ghana. The first is one that is negotiated directly with a private firm, and the other is one that is initiated and orchestrated by AATF, the technology transfer and management organization introduced earlier. In any given project, especially those overseen by AATF, there are a dizzying number of actors and organizations involved, all with differing agendas, interests, roles, and norms (see Figure 1). One example of an AATF-managed project is the *Bt* cowpea, a multi-country initiative overseen by AATF and funded by USAID. The genetic material central to the project—the *Bt* trait—was leased by Monsanto, and the actual transformation event—modifying cowpea with the *Bt* trait—took place at the Australian Commonwealth Scientific and Industrial Research Organization. There is also a plethora of contextual factors that shape whether and how a project will proceed, as proponents of agricultural biotechnology are well aware. As we illustrate in the vignettes below, the complex choreographies required to move a project from conception to market present a number of opportunities for a project to warp, collapse, and be contested.

*Vignette #1. The plant breeders bill: patents and resistance*⁶⁶

In 2013, a bill developed by the Alliance for a Green Revolution in Africa (an organization funded by both the Gates and Rockefeller foundations), was introduced for consideration into Ghanaian Parliament.⁶⁷ The bill, entitled the Plant Breeders Bill, would institute the country's first IPR regime related to plants. Under the proposed legislation, a plant breeder (defined as a citizen, resident, or legal entity in Ghana) may file for exclusive rights for 'new, distinct, uniform, and stable' varieties of plants.⁶⁸ The Plant Breeders Bill is part of three-part package meant to liberalize the Ghanaian seed sector. The first piece of legislation, the Plants and Fertilizer Act, was passed in 2010 and allowed private breeders to enter the Ghanaian market, and the second, the Biosafety Act (described above) was passed a year later.

Soon after the Plant Breeders Bill entered Parliament, Accra's well-established civil society networks began circulating copies of the text and debating the contents of the bill. Eventually, after a series of meetings at the Freedom Centre, a network called the Ghanaian Food Sovereignty Platform emerged. The Platform consists of several already-established organizations and one new entity (Food Sovereignty Ghana, not to be con-

66 If not otherwise cited, the material in these vignettes comes from Rock, 'We are not starving'.

67 AGRA, '2013 program performance scorecard', (The Alliance for a Green Revolution in Africa, Nairobi, 2013).

68 Parliament of Ghana, *Plant Breeders Act, 2013*, 28 May 2013, <https://tasai.org/wp-content/themes/tasai2016/info_portal/Ghana/Ghana%20Plant%20Breeders%20Bill.pdf> (1 June 2019).

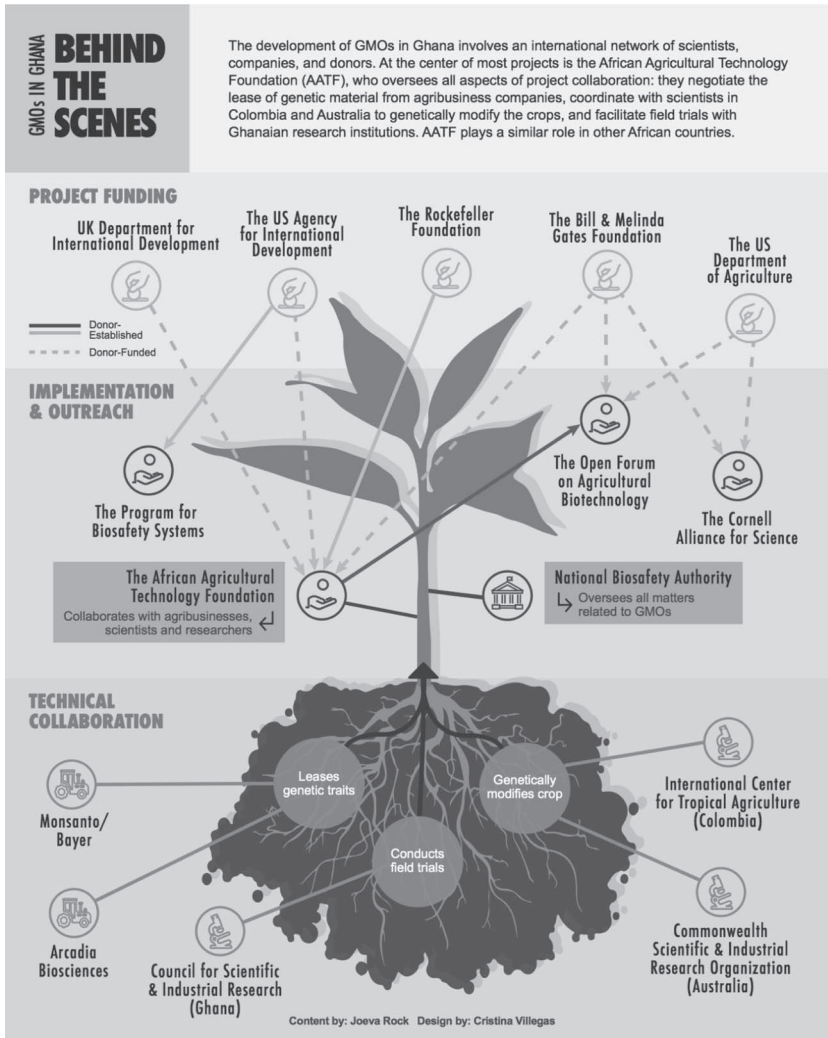


Figure 1 The network of biotech actors in Ghana.

fused with the Platform). It initially organized around questions related to biotechnology, and more broadly, around the role donors play in determining the country's food and agricultural policies. The Platform opposed the bill based on its strict definition of what sorts of plants would be protected, i.e., only new or novel varieties. Such a narrow definition, the group argued, privileged multinational companies, which had the capabilities to develop such seeds. Citing a long history of failed seed and input schemes, the

group also called for a moratorium on GM crops and argued that they were ill-suited for Ghanaian farmers.⁶⁹

Due to the established networks of some of its members, such as the Peasant Farmers Association of Ghana, the General Agricultural Workers Union, and the Center for Indigenous Knowledge and Organization, the Platform was able to quickly mobilize farmers across the country. Activists took their concerns to the public and organized street level protests, appeared on radio and television shows, circulated memes on social media, published manifestos with farmers, and threatened to ‘vote out’ any member of Parliament that voted for the bill.⁷⁰ The Platform’s message was not only backed by farmer organizations but also by Samia Nkrumah, a well-known politician and daughter of Kwame Nkrumah. Speaking at a street protest in 2014, Samia addressed the crowd: ‘We do not control our economy, we do not control the prices of our commodities, of our gold, of our cocoa, so cannot we even control our food?’⁷¹ In doing so, Samia, and others in the Platform, made explicit links between contemporary struggles for food sovereignty and historical anti-colonial struggles for political sovereignty.

In a country where about half of the adult population is engaged in agriculture, the Platform’s widespread organization of farmers put the Bill’s proponents on the defensive. The initial strategy of Ghanaian and international proponents was to describe the bill as having ‘nothing to do with [GM crops]’⁷² but rather, represented a way to ‘thank’ Ghanaian plant breeders for their work.⁷³ ‘The [P]lant [B]reeders’ [B]ill is simply to provide royalties and serves to motivate the breeders, protect our seeds and fetch the much needed foreign exchange revenues for Ghana’, said the head of OFAB-Ghana in a 2014 interview.⁷⁴ Despite these efforts, the bill’s likely beneficiaries were obvious. In an internal report from the parliamentary committee overseeing the bill, lawmakers expressed how plant patents would spur competition amongst researchers and industry,

69 Rock, ‘We are not starving’.

70 Faustine Akwa, ‘Brong Ahafo chiefs, farmers vow to vote out MPs if...’, *Modern Ghana*, 6 November 2014, <<https://www.modernghana.com/news/579385/brong-ahafo-chiefs-farmers-vow-to-vote-out-mps-if.html>> (14 May 2019).

71 ‘Ghanaians take a stand against GMOs’, 1 February 2014, CGTN Africa, <<https://www.youtube.com/watch?v=zPBEpAXm0IQ&t=13s>> (24 May 2019).

72 Charles Benoni Okine, ‘Govt to support farmers with modern tech’, *Graphic Online*, 31 January 2017, <<https://www.graphic.com.gh/business/business-news/govt-to-support-farmers-with-modern-tech.html>> (14 May 2019).

73 Hillary Mireku Bortey, ‘Misconceptions about the Plant Breeders’ Rights system’, *Modern Ghana*, 27 April 2016, <<https://www.modernghana.com/news/688640/misconceptions-about-the-plant-breeders-rights-system.html>> (14 May 2019).

74 Joseph Gakpo, ‘GM foods are not harmful—OFAB Ghana chapter’, *Myjoyonline.com*, 13 June 2014, <<http://www.myjoyonline.com/news/2014/june-13th/gm-foods-are-not-harmful-ofab-ghana-chapter.php>> (14 May 2019).

and importantly, open the door for GM seeds.⁷⁵ ‘We are a market for them’, a Ghanaian research scientist told Rock in 2014, noting that companies were waiting for the Plant Breeders Bill to be passed before establishing a presence in country.⁷⁶ Another scientist Rock met at an OFAB-, PBS-, and Cornell Alliance for Science-funded workshop for Ghanaian parliamentarians casually revealed that not only would biotech companies not enter Ghana without the Bill in place, but that they would not allow projects overseen by AATF to be commercialized either.⁷⁷ This revelation—that companies were withholding permission to commercialize—complicates what biotech proponents tell the public, namely, that activists are solely to blame for delayed commercialization, and that the Plant Breeders Bill is solely to encourage local breeders.

At the time of writing, despite impressive efforts by biotech proponents, the Plant Breeders Bill has yet to be debated or come to vote in parliament, let alone passed. Activists consider this a victory. Meanwhile, the bill’s proponents have recently changed their strategy, acknowledging for the first time that ‘the bill is also expected to enhance the environment to allow for the introduction of biotech crops’.⁷⁸ Although it is unclear what will happen to the bill going forward, the last 7 years of debate demonstrate the importance of local context in understanding the fate of biotech in Africa. In this case, a history of faulty agricultural technologies led to the birth of a social movement that has put up an impressive fight against GM crops and raised resonant questions for many Ghanaians. Such opposition has made it difficult for donors and Ghanaian officials to create the laws and regulations needed to satisfy private sector actors, even though they have tried hard to do so. And as the next vignette will demonstrate, industry partners have become tired of waiting for such laws to be in place.

Vignette #2. Bt cotton, donor reluctance and bad business

One of the first biotech projects to begin in Ghana was a direct public-private partnership between Monsanto and the Ghanaian Council of Scientific and Industrial Research. For years, Ghanaian and Monsanto officials conducted field trials and testing of *Bt* cotton on Ghanaian fields, hoping to revive Ghana’s all but dead cotton sector. However, in May 2017, Ghanaian media reported that *Bt* cotton trials were suspended indefinitely.

75 Committee on Constitutional, Legal and Parliamentary Affairs, Report of the *Committee on Constitutional, Legal and Parliamentary Affairs on the Plant Breeders Bill* (November 2013).

76 Interview, scientist, Accra, Ghana, 1 July 2014.

77 Interview, scientist, Koforidua, Ghana, 19 March 2016.

78 Joseph Gakpo, ‘Ghana urged to pass law to encourage improved seed breeding’, 15 November 2018, *Alliance for Science*, <<https://allianceforscience.cornell.edu/blog/2018/11/ghana-urged-pass-law-encourage-improved-seed-breeding/>> (14 May 2019).

That the cotton project had not been successful in a country where little cotton is grown was not surprising. But two aspects of the announcement left room for further inquiry. The first was that Monsanto, which had provided the funding and genetic material for the project, had withdrawn its support. The second was that the project had ended almost a year prior to being announced publicly. Why did it take so long for the news to enter the public domain? And why did Monsanto exit the project, which had completed almost 3 years of field trials and was reportedly close to commercialization?⁷⁹

At the time of the decision, Monsanto had recently ended operations in Burkina Faso, Ghana's northern neighbor, after a dispute over *Bt* cotton performance.⁸⁰ Monsanto handled its business in Ghana from Burkina Faso, testing samples from Ghanaian field trials and hosting Ghanaian farmers, scientists, and officials in Burkina Faso for 'seeing is believing' events.⁸¹ However, despite their geographical proximity, the country's cotton sectors could not be more dissimilar: Burkina Faso has a robust and vertically organized cotton industry, while Ghana's cotton sector collapsed in the 1980s and has since struggled to restart.

The project's suspension left Ghanaian officials and scientists disappointed. Their disappointment only escalated when Nigeria approved Monsanto's *Bt* cotton for commercial release in 2018 after just a few years of research. Nigeria's relatively quick research-to-market pipeline has reinvigorated talk about *Bt* cotton in Ghana, at least from biotech proponents, and Ghanaian officials have made public appeals for a new funder to finance the remainder of the field trials. Largely absent from these discussions is Monsanto, the sole technological and financial project partner whose withdrawal caused the project to collapse. And it was Monsanto, not CSIR nor Dr. Chamba, that unilaterally decided to end the project. Explaining their reason for leaving, Monsanto's Vice President of Commercial and Global Supply Chain explained that continuing work in the country was bad business: 'In Ghana, or in any other African country, if we see respect for intellectual property[,], a functional regulatory system, respect for private contracts, and ability for us to bring value and be rewarded for the value we create, if we have those four principles, we will always be there to participate... It was a business decision. We

79 'GMO Cotton', *Joy News*, 12 May 2017, <https://www.youtube.com/watch?v=12Q6RF_sC4o> (15 May 2019).

80 Joe Baviera, 'Burkina Faso settles dispute with Monsanto over genetically modified cotton', *Reuters*, 8 March 2017, <<https://af.reuters.com/article/africaTech/idAFKBN16F1MP-OZATP>> (14 May 2019).

81 'Big deal for cotton, textile industry', *Business and Financial Times*, 19 November 2015, <<https://www.ghanaweb.com/GhanaHomePage/business/Big-deal-for-cotton-textile-industry-394936>> (15 May 2019).

couldn't afford to keep on investing and not seeing light at the end of the tunnel'.⁸²

Without Monsanto's partnership, there is no way the project can continue, with or without a source of funding. Indeed, funding is just one part of the biotech equation; the proprietary technology, in this case the *Bt* gene, is the other requirement. Herein lies an important aspect of biotech projects in Africa that receives little attention: without corporate partners leasing genetic technology, these projects cease to exist. Thus, projects such as the *Bt* cotton example illustrate two types of risks of relying on for-profit partners. First, there's the risk of losing out on years of work; even though Ghanaian institutions are not directly funding the biotech projects, Ghanaian PIs, bench scientists, and officials expend energy and intellectual and physical labor on the projects. Second, there's the risk of losing access to a technology, should the private partner choose to end the project prematurely. Together, these risks trouble our understanding of what might make a technology, seed, or project 'sustainable'.

Vignette #3. NEWEST rice: from a triple threat to a single gene

In 2019, a Ghanaian journalist and former Cornell Alliance for Science fellow published an article entitled, 'High expectations for GMO rice research in Ghana'.⁸³ The article, relying heavily on a study by the International Food Policy Research Institute (IFPRI), provided updates on an AATF-facilitated research project in Ghana, Uganda, and Nigeria called the NEWEST rice project.⁸⁴ Under the NEWEST umbrella, project coordinators planned to genetically modify NERICA4, an upland variety of rice, in two ways: first, by developing a single-trait nitrogen use efficient (NUE) rice; and second, by developing a triple-stacked, nitrogen use efficiency, water efficiency, and salt tolerance (NEWEST) rice (see Table 1.) The article reported that 'Confined field trials conducted on a GM variety with just the nitrogen use-efficiency trait showed it increased yields by between 14 and 25 percent over traditional varieties' and that 'both farmers and Ghanaian scientists... believe the improved variety will better the lives of smallholder rice farmers'.⁸⁵ However, missing from the article was that

82 Abubakar Ibrahim, 'We are still open to resuming GMO work in Ghana—Monsanto', *Myjoyonline.com*, 16 February 2018, <<https://www.myjoyonline.com/news/2018/February-16th/we-are-still-open-to-resuming-gmo-work-in-ghana-monsanto.php>> (14 May 2019).

83 Joseph Opoku Gakpo, 'High expectations for GMO rice research in Ghana', 29 January 2019, *Alliance for Science*, <<https://allianceforscience.cornell.edu/blog/2019/01/high-expectations-gmo-rice-research-ghana/>> (14 May 2019).

84 It is worth noting that this project began in Uganda and Nigeria before either country had biosafety laws in place. At the time of this writing, Uganda still has not enacted a biosafety law.

85 Gakpo, 'High expectations'.

funding for the triple-stacked NEWEST rice was suspended in 2016, leaving scientists to focus solely on the single trait NUE rice.⁸⁶

According to a Ghanaian official close to the project, soon after President Donald Trump was sworn into office in January 2017, USAID—one of the main financiers of the project—instructed AATF that it was reducing funding to the rice project.⁸⁷ It is unclear exactly what transpired, but according to our informant, somehow the decision was made, either at the level of AATF or USAID, to suspend further testing on the triple-stacked (NEWEST) component and to instead focus on completing only the NUE project. The official we spoke with was frustrated; the team had just spent money completing a rain-out shelter needed to mimic drought and test for water efficiency, and the reduction in funding left the team leaders short on funds to pay their staff.⁸⁸

For Ghana, as well as for other African countries, the case of NEWEST rice demonstrates the difficulties of relying on external actors for access to gene technologies, whether donors, companies, or scientific institutes. In the NEWEST rice case (as with *Bt* cotton), the exit of an external actor put the brakes on years of work, leaving Ghanaian counterparts unable to pay their staff and to complete their experiments. Gakpo reports that the project's PI is waiting for 'the gene [to be] de-regulated' so that his team 'can backcross it into most of the popular jasmine types that we have locally'.⁸⁹ Here, the scientist's statement indirectly suggests that the current variety used for the NEWEST/NUE project is not as popular as other varieties. What's more, even if the gene were to be deregulated, no Ghanaian lab currently possesses the ability to genetically modify rice. This raises the question of whether Ghanaian scientists would again have to rely on external actors, and if so, what legal infrastructure would need to be in place to meet their demands.

Overall, while Ghana's experience with *Bt* cotton signifies the importance of centering profit motives in our analysis, the NEWEST rice case demonstrates how donor politics shape African biotech projects. In fact, the central role that donors—whose strategies and funding missions are constantly in flux and not necessarily complementary—play in African biotechnology projects may be one of the more unstable aspects of these complex configurations.

86 The IFPRI report also raised questions around potential adoption rates of GM NERICA4. The report noted that non-GM NERICA4 currently has a 2.3 percent adoption rate, and predicted that if commercialized, GM NERICA would only see a 5 percent adoption rate; Fred Dzanku, Patricia Zambrano, Ulrike Wood-Sichra, José Falck-Zepeda, Judy A. Chambers, Hillary Hanson and Paul Boadu, 'Adoption of GM crops in Ghana: Ex ante estimations for insect-resistant cowpea and nitrogen-use efficient rice', (IFPRI discussion paper 1775, IFPRI, Washington, DC, 2018), p. 27.

87 Interview, anonymous, Accra, Ghana, 25 July 2018.

88 *Ibid.*

89 Gakpo, 'High expectations'.

Political and institutional reconfigurations

Regardless of whether GM crops are commercialized in Ghana, efforts to ‘modernize’ African agriculture and to pave the way for agricultural biotechnology have led to real-time political, institutional, economic, and media-related reconfigurations in Ghana, as well as in other African countries. In this section, we identify some of the reconfigurations that are either in motion or completed. While some of these are not solely related to efforts to promote GM crops in Africa, they are all part of the same concerted effort donors are making in the name of sparking a new African ‘Green Revolution’.

Key to this transformation is the liberalization of seed laws to allow private breeders, and thus companies, to operate. Development donors have worked actively throughout the continent to pass reforms. For instance, from 2006 to 2011, USAID funded the West African Seed Alliance (WASA), a \$13.5 million project that sought to reform seed laws across West Africa. The project was facilitated by USAID; implemented by the Alliance for a Green Revolution in Africa, Iowa State University and a non-profit agribusiness consulting firm called Cultivating New Frontiers in Agriculture (formerly Citizens Network for Foreign Affairs); and involved a number of private industry partners including DuPont Pioneer and Monsanto. The goal of the project was to prompt African governments ‘to continue withdrawing from the seed sector in the favor of the private sector’.⁹⁰ As a result of the WASA project, five countries reformed their seed laws to allow for private sector participation. In Ghana, where plant breeding had previously been confined to state or state-funded scientific institutions, WASA officials helped facilitate the passage of the Plants and Fertilizer Act, which allowed hybrid maize to be commercialized for the first time. As a result, in 2014, both DuPont Pioneer and Pannar (a DuPont Pioneer subsidiary) released hybrid maize varieties, established demonstration plots with the assistance of USAID, and, in the case of DuPont, partnered with the 4H Club to circulate hybrid maize seeds to Ghanaian student garden clubs.⁹¹

As noted earlier, biotech proponents claim that biotech projects are homegrown, meant to benefit public breeders and strengthen the capacity of state institutions. However, as documents from the WASA project demonstrate, USAID foresees plant breeding being turned over to the private sector.⁹² This has significant implications for state breeding pro-

90 USAID, ‘Request for applications West Africa Seed Program’, (United States Agency for International Development, 2012), p. 55.

91 Kiera Butler, ‘How America’s favorite baby-goat club is helping Big Ag take over farming in Africa’, *Mother Jones*, November 2014, <<https://www.motherjones.com/environment/2014/11/4h-africa-farming-dupont-hybrid-seeds/>> (14 May 2019).

92 USAID, ‘Request for applications’, p. 55.

grams as well as for local seed operations, which are unlikely to be able to compete against large MNCs. Furthermore, if the history of the agricultural biotechnology industry is any guide, any African seed companies that do manage to be successful are likely to be acquired by these multinational biotechnology firms.⁹³ While we do not mean to suggest that state plant breeding and seed replication programs do not have shortcomings, such structural changes are concerning, for they could raise the price of seeds (which would be especially detrimental for poor farmers), narrow seed supply to varieties that are the most profitable for seed and biotechnology firms rather than addressing the felt needs of African farmers, consolidate control over seeds in the hands of a few globally dominant multinational firms, and reduce crop genetic diversity.

For their part, the emergence of AATF, OFAB, and PBS has helped reconfigure African political, legal, and media spheres. They occupy space as supposedly ‘civil society’ organizations while being embedded within larger foreign or international bodies. PBS, for instance, is embedded within the Washington, DC-based IFPRI, and has played an instrumental role in helping to catalyze the passage of biosafety bills and establishing controlled field trials of biotech crops in Kenya, Nigeria, and Uganda.⁹⁴ PBS works closely with the African Union’s continental biosafety body, the African Biosafety Network of Expertise, an organization established through a partnership between the AU-NEPAD and researchers at Michigan State University and funded by the Gates Foundation.⁹⁵

Meanwhile, OFAB country chapters are integrated into state bodies in almost every country in which the organization is active. For instance, in Nigeria, OFAB is ‘co-hosted’ by the National Biotechnology Development Agency and the Agricultural Research Council; in Burkina Faso, OFAB is housed within the Institute for Environmental and Agricultural Research; in Ethiopia, OFAB is hosted by the Ethiopian Institute for Agricultural Research; and in Ghana, OFAB is integrated in the Council of Scientific and Industrial Research, the body currently undertaking all biotech research. Being housed within governmental agencies provides OFAB with

93 Philip Howard, ‘Global seed industry changes since 2013’, 31 December 2018, *philhoward.net*, <<https://philhoward.net/2018/12/31/global-seed-industry-changes-since-2013/>> (14 May 2019).

94 ‘2013 program for biosafety systems’, *IFPRI*, 15 August 2013, <<http://outcomestories.ifpri.info/2013/08/15/the-program-for-biosafety-systems/>> (24 May 2019); ‘2017 program for biosafety systems’, *IFPRI*, 11 September 2017, <<http://outcomestories.ifpri.info/2017/09/11/program-for-biosafety-systems/>> (24 May 2019); ‘2017 Annual Report’, (International Food Policy Research Institute, 2018).

95 Judith A. Chambers, Patricia Zambrano, José Benjamin Falck-Zepeda, Guillaume P. Gruère, Debdatta Sengupta and Karen Hokanson, ‘GM agricultural technologies for Africa: A state of affairs’, (IFPRI and African Development Bank, Washington, DC, 2014); ‘The new partnership for Africa’s development’, *African Biosafety Network of Expertise*, 2019, <<http://www.nepad.org/programme/african-biosafety-network-expertise-abne>> (14 May 2019).

credibility, legitimacy, and access to policymakers, all of which give it an outsized influence on public policy. For example, OFAB takes credit for lobbying for biosafety policies in Ethiopia, Ghana, Kenya, Nigeria, Tanzania, and Uganda.⁹⁶ Moreover, such positioning also augments the organization's ability to narrow the discourse to a purely 'science-based' assessment of biotechnology's risks and to delegitimise other economic, social, cultural, and environmental concerns. This is the approach that was taken in the home of OFAB's central source of funding, namely, the USA.

Hosting workshops for journalists and members of the media has been a mainstay for OFAB. To date, OFAB has hosted media trainings in at least six African countries, but notes that, at least in the case of Ghana, there is not yet a 'critical mass of writers and editors in ... newsrooms' to '[set] the record straight and [counter] well-orchestrated anti-biotech propaganda disseminated by national and international anti-GM groups'.⁹⁷ OFAB thus seeks to 'target newly employed journalists and editors who might not understand biotechnology' in hopes of reaching them before 'opponents of the technology' do.⁹⁸ In Tanzania, OFAB helped create the Tanzania Agricultural Journalists Forum, a group that boasts over 100 members.⁹⁹ OFAB reports that:

These media sensitisation and capacity building initiatives have been very effective in changing how the media reports on biotechnology. According to Philbert Nyinondi, the National Coordinator of OFAB-Tanzania, media reporting on agricultural biotechnology has more than tripled to a total of about 240 annually in both print and broadcast media. More importantly, the reports are now more factual and balanced unlike the false, fear-mongering and negative reports that used to be published before 2009.¹⁰⁰

Training journalists and lawyers is a way that OFAB and other biotech proponents attempt to establish agreement around biotech, as well as creating a cadre of professionals to defend it. In 2017, the US Embassy in Ghana also held a 5-day 'media outreach program' in three Ghanaian cities. Speakers included officials from the US embassy, the National Biosafety Authority, PBS, Ghanaian scientists, and Fulbright fellows. This underscores the immense resources being devoted to shaping the Ghanaian journalistic field and reveals the powerful actors behind these efforts. In some instances, biotech proponents have succeeded in bringing entire journalistic organizations into the fold. The Ghana Agricultural and Rural

96 AATF, 'OFAB: A decade of success'.

97 *Ibid.* p. 52.

98 *Ibid.*

99 *Ibid.* p. 43.

100 *Ibid.* p. 44.

Development Journalists Association (GARDJA) is one such example. GARDJA originally consisted of journalists bound by an interest in environmental reporting and who organized themselves over WhatsApp, but now serves as an organizer of pro-GM crops events in country. In 2018, GARDJA's project administrator was awarded a fellowship at the Cornell Alliance for Science and subsequently serves as an official for the Alliance for Science Ghana chapter.

The reconfigurations noted here are just some of the institutional and political-economic changes underway in the name of advancing a single (bio)technology. While this does not mean that GM crops will spread through the continent, these changes are likely to alter the structure of agriculture in particular countries, with important distributional and social consequences.

Conclusion

Whether or not GM crops are ultimately adopted on the continent, by whom, and under what circumstances will depend on the ongoing interaction of a wide range of domestic and foreign social, economic, political, and scientific factors, as we have suggested throughout this article. While proponents of agricultural biotechnology frequently blame anti-biotech activists for 'starving' Africans for science (Paarlberg 2009), our analysis indicates that there are a multitude of reasons that GM crops have not spread across the continent. In the case of the Ghanaian Plant Breeders' Bill, which would have extended proprietary rights over novel plant genetic modifications, it was indeed activist organizing that challenged the bill, without which companies would not let their technologies be commercialized in Ghana. Our other two Ghanaian vignettes, however, revealed other factors at play. Ghana's *Bt* cotton project was abandoned because the company involved, Monsanto, decided it was not economical to continue its involvement in the country, while the NEWEST rice initiative ended because USAID funds were cut and one of the project partners decided to focus on NUE rice instead. The collection of case studies from Ghana, Burkina Faso, and South Africa indicate that the economic calculus of multinational companies and the politics of foreign aid donors loom large in determining the future of biotechnology in Africa, which is not surprising, given their central role in these projects. These experiences also constitute important reminders that the Africans who work on these 'collaborative' projects typically have little say in their fate, as decisions about whether to continue, pause, or end any given project remain fundamentally with outside actors.

Our multicountry analysis reveals the inherent fragility of efforts to introduce GM crops into African agriculture—a fragility that derives from

the multiplicity of conditions that must simultaneously obtain for an agricultural biotechnology project to go forward. To wit, external donors must be relied upon to supply monies for projects that often take upwards of 8 to 10 years; biotechnology companies must agree to share their proprietary technologies and see their engagement in African biotechnology projects as being in their interests; legal frameworks that satisfy the owners of gene technologies—mainly, MNCs—have to be established; relationships among organizations with different motives, agendas, organizational cultures, and degrees of power have to be built and maintained over long periods; external partners (aid agencies, philanthropic foundations, and multinational firms) must remain satisfied that their resources are not being wasted; public support must be cultivated; activist and public opposition must be kept at bay; concerns about encroachments on sovereignty must be overcome; the GM crop varieties that are produced must be affordable and profitable for farmers; and farmers and sellers must see them as attractive. Seldom is this complex choreography successfully achieved. This, to answer Lawrence Kent's deceptively simple question, is the hold up.¹⁰¹

Finally, the analysis presented here builds on and extends the political economy of biotechnology in Africa literature in two significant ways. First, it indicates that critics were right to be concerned about what would happen to agricultural research in Africa when the new science of genetic engineering became privatized.¹⁰² While the MNCs have not blocked the flow of knowledge and information among scientists (although genetic materials and information no longer flow amongst scientists unhampered), private corporations serve as the ultimate arbiter of what genetic technologies get shared and under what conditions. On some occasions, firms have held up the spread of scientific information and modified genes that African scientists would like to use, either because these companies do not perceive this sharing to be in their interest or because they believe that a particular country's legal-institutional environment (i.e., its intellectual property protection and liability laws) does not sufficiently protect their investments. While this is certainly understandable from a business perspective, it is inimical to achieving the public good. This is a deeply problematic constraint when it prevents agricultural research from being done that could improve African food security and address the continent's many pressing agricultural challenges, especially climate change.

Second, our analysis reveals the significant efforts being made by a transnational network of biotech advocates who are seeking to induce legal and institutional reforms in African countries—reforms that reflect

101 Kent, 'What's the holdup?'

102 Buttel, Kenney and Kloppenburg Jr., 'Biotechnology and the third world'; Juma, *The gene hunters*; Kloppenburg Jr., *First the seed*; Meagher, 'Institutionalising the bio-revolution'.

the priorities and interests of foreign corporations and their governments, instead of those of African farmers, consumers, and/or their governments. These efforts, which range from providing technical training in biosafety assessment and developing IPR legislation to influencing journalists and the news media to take a pro-biotechnology stance, are wholly funded by foreign aid donors (in particular, the US government) and private foundations. This raises the question of who is making the decisions about whether to embrace GM crops, as well as about the laws, policies, and procedures that will govern their introduction and utilization. As we have suggested here, these institutional reforms are likely to significantly alter the structure of agriculture in African countries and the role of the public and private sectors. It is this, as much as the crops themselves, that many should find concerning.