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POLICY BRIDGE

Fields of contestation and contamination: Maize seeds, agroecology and the (de)coloniality of agriculture in Malawi and South Africa

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Farmer-managed seed systems and the conservation of agrobiodiversity are increasingly recognized as important components of food and seed sovereignty. In contrast, hybrid, genetically modified (GM), and, increasingly, gene-edited crops continue to be promoted by Green Revolution proponents as a "climate smart" package that includes fertilizers, pesticides, purchased seeds, and links to global markets. Influencing seed laws and policies to support the uptake of modern crop varieties has been a key entry point in many countries, facilitated by networks of foreign donors, philanthropists, governments, and multinational companies. Using the case of South Africa, where GM crops have been grown for several decades, we provide insights on implications for Malawi, which passed a Seed Act in 2022, implicitly supporting GM crops. Both countries have histories of colonial agriculture with strong policy support for modern, hybrid varieties of maize, and the replacement (and displacement) of local, open-pollinated maize varieties. In South Africa, several studies have revealed the contamination of smallholder fields and seed systems. Through a political ecology lens, we explore how maize and its cotechnologies were commodified in South Africa and Malawi, and what South African experiences of GM crop adoption in smallholder farming systems can tell us about the challenges to be faced by smallholder Malawian farmers. We reveal how colonial histories and ongoing colonialities of power, knowledge, being, and nature continue to shape the character and form of agriculture in both countries, running counter to the needs of agroecological smallholder farmers and their ways of knowing and being. We conclude by envisioning what reimagined, transformed and decolonial approaches for food and agriculture might look like on the African continent, and how they might contribute toward the attainment of food and seed sovereignty and an agroecological future.

Keywords: Agroecology, Decoloniality, Food and seed sovereignty, Genetically modified crops, Africa, Maize

Introduction

African food and seed systems are strongly rooted in the diversity and richness of local cultures, ecologies, knowledges, and values (Wynberg, 2024). In many African countries, these traditional systems are changing rapidly, due in large part to colonial histories and the driving forces of capitalism, both shaping and distorting the ways in which people eat and farm (Rock, 2019; Westengen et al., 2019; Rock and Schurman, 2020; Kesselman, 2023). Along with transforming cultures, identities, and ways of being and knowing, impacts of the expanding industrial food and agricultural system in Africa include increasingly unequal access to nutritious foods, the expanding presence of ultra-processed food companies and associated negative health implications, destructive climate effects, and the pollution and degradation of the region's soils, waters, and biodiversity (Patel, 2022; Gómez, 2023). Such changes are closely paralleled on the continent by increased market concentration and corporate power.

Alongside these trends is an emerging focus on technological solutions to address agricultural production and food security (Horton et al., 2021), including hybrid and genetically modified (GM) seeds, synthetic fertilizers, and other agrochemicals. This package of interventions is central to many agricultural development interventions on the continent, materializing in the form of seed laws and policies, financial incentive schemes, and public–private partnerships. Closely aligned with policies of economic liberalization, these initiatives typically arise from externally driven programs such as the Alliance for a Green Revolution in Africa (AGRA), and other networks of foreign donors, philanthropists, and multinational companies which target Africa's seemingly "unproductive" lands as an opportunity to enhance the productivity of African smallholder farmers (Rockefeller Foundation, 2006; AGRA, 2019). This "new" African Green Revolution,

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which has its roots in philanthropic initiatives of the Rockefeller and Gates Foundations (Holt-Giménez, 2008), culminating in the launch of AGRA in 2006, is premised on the basis that Africa "missed the boat" of previous agricultural breakthroughs and that the continent is now "the Final Frontier" for biotech crops (Karembu et al., 2009). In parallel, recognition of the injustices of the food and agricultural system is leading to a growing political consciousness (Nyeleni, 2007; United Nations, 2018). These contrasting dynamics are seen in the context of a continent grappling for solutions to the environmental and economic poly-crises it faces, and increased scholarly attention as to how the long-standing patterns of power and knowledge domination, entrenched through colonialism, persist and permeate contemporary food, seed, and knowledge systems (Patel, 2022; Kruger et al., 2023).

This article explores the case of 2 African countries with long histories of colonial intervention—South Africa and Malawi—to interrogate the way in which seed and related policies and the introduction of hybrid and GM crops have been used to perpetuate an agenda of coloniality and domination. We unravel the implications of these interventions, and their positioning in 2 countries which share histories of colonial agriculture and export-oriented agricultural systems. Both countries have witnessed strong policy support for the uptake of modern, hybrid varieties of maize, and the subsequent replacement (and displacement) of indigenous crops and local maize varieties (Khumalo et al., 2012). Although agriculture in South Africa is far more industrialized and bears the legacy of Apartheid's structured segregation of commercial (white) and subsistence (black) farms, both countries include the strong presence of neoliberal reforms and commodity agriculture. A significant difference between the countries lies in their uptake of GM crops. South Africa was the first African country to begin growing GM crops at an industrial scale, and the first nation in the world to produce a GM subsistence crop and staple food: insect-resistant and herbicide-tolerant white maize, typically consumed daily as a porridge, especially by poorer communities (Gouse et al., 2005; Wynberg and Fig, 2013). While the Government of Malawi (GOM) has always had a more accepting approach to GM crops than its neighbors, it has not yet approved any for commercial release, although several field trials of GM crops are underway. Another principal difference between the 2 countries is in the extent to which smallholder farmers rely on local, open-pollinated, and traditional varieties. While the loss of agrobiodiversity is acute in both countries, it is profound in South Africa, a country where some 80% of the agricultural land is used for industrial farming (Vink and Kirsten, 2003). Although agrobiodiversity loss is also severe in Malawi (Chibwana et al., 2012; Snapp et al., 2019), the extent to which it remains intact and in use by smallholder farmers is far more prevalent. The strong reliance of smallholder Malawian farmers on a diverse range of seeds, including traditional maize varieties, raises concerns given the well-documented outcrossing and spread of transgenic traits into open-pollinated maize varieties (Jacobson and Myhr, 2013; Iversen et al., 2014).

The stimulus for this article stemmed from the surprising news, received in April 2022, that the Malawian government had passed a Seed Act recognizing GM crops as 2 of 4 types of certified seed, effectively paving the way for the use and sale of GM seeds in the country. One of the authors of this article (RW) was in Malawi at the time conducting research on community seed banks and had been privy to a conversation confirming the involvement of AGRA in this policy change. In addition to her academic role, RW is a founding member and trustee of the NGO Biowatch South Africa, working to secure food and seed sovereignty among small-scale farmers in South Africa, and has been involved since 1995 in policy research on GM crop adoption in South Africa. This research included a recent project that illuminated the social and agronomic implications of GM contamination for small-scale agroecological farmers. RBK, a US-based researcher with over 2 decades of research in Malawi in collaboration with local agroecological organizations, was also in Malawi during the release of the Seed Act and had participated in current and earlier policy discussions of the 2018 Seed Policy and Seed Bill. Discussions ensued as to the possible implications for Malawi, and the 3 million or more smallholder farmers, comprising 99% of all farmers in Malawi who rely on farm-saved seed (Muyanga et al., 2020). Clear possibilities arose for thinking anew about the way in which food and agricultural policies were formulated and implemented.

In this article, we ask 2 questions: first, what does the combined history of hybrid and GM crop adoption in smallholder farming systems in South Africa tell us about the challenges to be faced by smallholder farmers in maintaining diverse cropping systems in Malawi, with the likelihood of increased use and spread of GM crops? Second, and building on this analysis, how can a decolonial framework help to explore intersecting possibilities of agroecological smallholder farming and seed sovereignty? Although our analysis is broad, we use maize as a lens—a "political crop" (Scott, 2017)—that brings with it a combined history of slavery, colonization, and modernization, but which has also evolved both as a commodity and a so-called "escape" crop that has avoided appropriation by the state, providing subsistence for marginalized smallholders (Scott, 2017; Fischer, 2022). Building on this analysis, we explore how colonial histories and ongoing colonialities of power, knowledge, and being intersect with agroecological smallholder farming and food and seed sovereignty, and what reimagined, transformed, and decolonial approaches for food and agriculture might look like on the continent.

The article is organized as follows. We start with an analytical framing, expanding on concepts of political ecology, food sovereignty, seed sovereignty, agroecology, coloniality, and decoloniality, and how they intersect. We then provide a synopsis of the history, evolution, and context of Africa's Green Revolution, with a focus on ways in which genetic technologies have been introduced on the continent. Detailed case studies of the seed politics of South Africa and Malawi follow, including a history of the politics of agriculture as it relates to hybrid and GM crops. Our discussion integrates the experiences of both countries and provides a scaffolding for ways in which we might reimagine and transform seed-related interventions.

Conceptual framework

We use a range of intersecting concepts in this article to contextualize the introduction of GM crops to South Africa and Malawi, and to interrogate their implications for agroecological approaches. Our overarching conceptual framework is that of political ecology, which provides a critical foundation for understanding the interactions between society, politics, and the environment, with the aim of informing policies and practices that promote more equitable and sustainable relationships between people and nature (Robbins, 2019). It uses a broad range of methods including ethnography, historical and discourse analysis, and field studies involving ecological data collection, combining a political economic analysis with concerns of ecology (Neumann, 2005, pp. 5–7). In this article, we place a particular focus on how political and profit-oriented economic systems, institutions, and ideologies have influenced the development and implementation of hybrid and GM seed policies, and the social and environmental consequences of these decisions.

We also lean heavily on the intertwined concepts of food and seed sovereignty. These concepts have emerged as a broad counter-narrative concept to technocratic, industrial, capitalist, and neoliberal approaches to agriculture and food security and the deep inequities and ecological damages created at first by 5 centuries of colonialism and, more recently, by the industrial agricultural system. Food sovereignty, first popularized by La Via Campesina, an international food justice movement, at the 1996 World Food Conference, is defined as "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Nyéléni, 2007). It is a rights-based framework which goes beyond a productionist approach to agriculture, focusing on people's right to control how and what kind of food is produced (Wittman et al., 2010).

Seed sovereignty, which refers to the rights of farmers to have control over their own seeds and the ability to save, breed, exchange, replant, and sell them as they see fit, is a concept that emphasizes the importance of preserving traditional and locally adapted seed varieties, as well as protecting the cultural and ecological knowledge associated with seed saving and agriculture (Adhikari, 2014). As Kloppenburg (2014) remarks, seed sovereignty is also a social movement, characterized by its opposition to intellectual property rights and GM crops, but also by a strong affirmative approach that embraces community seed saving and exchange, agroecology, and participatory plant breeding, farmers' rights and legal sovereignty over seed, and an openness to allies and alliances. As a "decommodification counter movement" (Hernández Rodríguez, 2023) and with seed "the first link in the food chain" (Adhikari, 2014), seed sovereignty is clearly the foundation of food sovereignty, by increasing democratic control over the building blocks of food production, enhancing resilience, and supporting cultural foodways (Bezner Kerr, 2013).

Agroecological approaches align closely with food and seed sovereignty; a core principle of agroecology is to maintain and enhance biodiversity, including functional diversity and genetic resources, as well as to foster financial autonomy by reducing dependencies on purchased, synthetic inputs on the farm, and preferentially using local, renewable resources (Wezel et al., 2020). Agroecological principles also address power and governance in the food system, and diversity in knowledge systems, including Indigenous ways of knowing. Agroecological approaches can strengthen resilience in the face of climate change and other shocks such as pandemics and rising food and fertilizer prices (Bezner Kerr et al., 2023; Kozanayi and van Niekerk, 2024). Though not all proponents of agroecology are explicitly against the use of hybrid and GM crops, an agroecological approach, with these principles, leans toward the use of local, open-pollinated seed varieties that can be reproduced at the farm level, and discourages the use of GM seeds (High-Level Panel of Experts on Food Security and Nutrition [HLPE], 2019). Furthermore, the highly concentrated nature of the current commercial seed sector, closely linked to the agrochemical industry, is also contrary to agroecological principles of fairness and the democratic governance of land and natural resources. Merging agroecology with the use of GM crops or other forms of biotechnology would require addressing thorny questions of technology sovereignty (Montenegro de Wit, 2022), including those as to who decides what technology to use, what problems it addresses, and who controls and benefits from it.

Our argument in this article is that GM crops perpetuate existing power imbalances within the food system, reproduce the underlying dynamics of colonial architecture, and heighten the marginalization of smallholder farmers. Understanding the impacts of GM crops in Africa thus requires an analysis of the legacies of colonialism, recognizing that the ecological, health, economic, and social crises of the industrial food and agricultural system are not only deeply embedded in these colonial histories but remain intensely visible through the ingrained colonialities and power relations that exist today.

As Maldonado-Torres (2007, p. 243) explains, "coloniality survives colonialism"; it is, Ndlovu-Gatsheni (2015, p. 488) elaborates, " . . . an invisible power structure, an epochal condition, and epistemological design" going beyond colonial administrations to define the way in which societies relate to each other, value their cultures, and produce knowledge. Combined, they characterize what Quijano (2000) refers to as the colonialities of power, knowledge, and being: of power, through the ongoing domination by foreign capital; of knowledge, through the privileging of Eurocentric knowledge and ways of knowing above any others; and of being, by affecting peoples' agency and dignity. More recently, a fourth dimension—that of the coloniality of nature—has been added to this conceptualization, meaning the implications of colonial power for human-nature and more-than-human-nature relations (Bohorquze, 2012 in Cubillos et al., 2023). It follows that decoloniality is a response to coloniality, manifested through resistance, thought, and action. It is, Maldonado-Torres (2011, p. 117 in Ndlovu-Gatsheni, 2015) explains, "the dismantling of relations of power and conceptions of knowledge that foment the reproduction of racial, gender and geo-political hierarchies that came into being or found new and more powerful forms of expression in the modern/colonial world."

Decolonial approaches, agroecology, and food sovereignty are increasingly in dialogue with one another (e.g., Figueroa-Helland et al., 2018; Montenegro de Wit, 2022), and offer mutually reinforcing possibilities for transformative shifts and progressive change. As Cubillos et al. (2023, p. 99) explain, agroecology has emerged as a "critical and counter-hegemonic field confronting the colonial project and . . . challenging the power relations where agriculture is subsumed." Cubillos et al. (2023) analyze these interactions through 3 scenarios. The first is political—using collective action and social movements to challenge the power relations of food and agriculture systems, and to seek alternatives to the hegemonic control and manipulation of humans and the more-than-human world. The second is epistemological—going beyond Western-dominated knowledge systems and scientific rationality to advocate for multiple ways of knowing about agriculture that recognize the traditional knowledge of farmers, and the importance of this knowledge for producing a diversity of nutritious, adapted, and resilient crops. The third is ontological—resonating with a more relational, holistic, and collective manner that moves away from "atomizing" society through dualistic, individualist, and reductionist approaches. Combined, decolonial approaches also can be seen to provide the framework for a rethinking of the human-nature relationship, giving life and meaning to Earth's diversity and the multiplicities of existence in the "pluri-verse" (Escobar, 2018).

Africa's New Green Revolution: Recolonizing the continent?

Impacts of colonization and the ongoing colonialities of agriculture are seen vividly in the uptake of Africa's New Green Revolution which, while heralded by some scientists and commentators (Annan, 2007), has not been so much a widespread revolution, but more of an undercover operation by a wide array of special forces, with unexpected twists and turns. The accompanying savior narrative, facilitated by northern-dominated programs such as AGRA and other networks of foreign donors, philanthropists, and multinational companies (Wise, 2020; Vicedom and Wynberg, 2023), and intended to replace public extension with agro-dealers and other private extension services, typically pronounces their benefits for Africa—a continent that purportedly "lost out" on the Green Revolution of the 1960s and 1970s (Norman, 1985; Frankema, 2014). The Green Revolution package of improved crop varieties, synthetic fertilizers, pesticides, and herbicides—connected to global markets (Patel, 2013)—is linked sometimes overtly and sometimes by direct association to hybrid and GM crops, with millions of dollars poured into this technocentric approach from private foundations (Moseley et al., 2015; Schurman, 2017; Rock and Schurman, 2020). Schnurr (2013), for example, reveals a murky, complex set of social relations involving development agencies, research institutions, and corporate actors which underpin the promotion and establishment of GM crops in Uganda. Material and institutional processes are all mobilized on behalf of GM crops, including legislative efforts at the national level (Schnurr, 2013). They also mirror the Eurocentric, racialized, capitalist patterns of domination put in place during colonialism, which disrupted traditional food and agricultural practices in South Africa and elsewhere (Kesselman, 2023) and imposed the form of agriculture now characterized by industrialization, monocropping, chemical inputs, and the use of hybrid, GM and, increasingly, gene-edited crops. As Kesselman (2023, p. 8) remarks, "the power of multinational, oligopolistic seed and input companies like Bayer (Monsanto) or food manufacturers like Nestlé is not so different from that of the Dutch East India Company three hundred years ago."

Narratives of success, often funded by advocacy "think-tanks" such as AGRA and the Cornell Alliance for Science, emphasize the benefits that hybrid varieties, and especially GM crops, hold for smallholder farmers and food security (Schnurr, 2012, 2013; Rock, 2019; Luna and Dowd-Uribe, 2020). In the case of Burkina Faso, promotion of *Bacillus thuringiensis* (Bt) cotton was heavily managed by multinational corporations, to the extent that key quality issues with the crop were ignored until the government decided to phase out Bt cotton in 2016. Luna and Dowd-Uribe (2020) reveal the ways that Monsanto held considerable power over the assessment of Bt cotton in this context, narrowing the evaluation of the crop in ways that overlooked key aspects and eventually led to its withdrawal, but not before the "Bt cotton success story" provided both profits for the company and widespread promotion of GM crops across Africa. In South Africa, the "success" of Bt cotton for smallholder farmers on the Makhatini flats of KwaZulu-Natal was used to promote GM crops as a viable option for smallholders throughout the continent (Witt et al., 2006; Schnurr, 2013). A carefully orchestrated campaign followed to promote the benefits of GM maize for South African smallholders, touting higher yields, fewer labor demands due to the use of broad-spectrum herbicides, and reduced exposure to harmful pesticides (Gouse et al., 2005; Keetch et al., 2005).

In 2019, the industry-funded and pro-biotech organization International Service for the Acquisition of Agri-biotech Applications (ISAAA) announced that 3 more African countries—Malawi, Nigeria, and Ethiopia—had "decided to harness the benefits of biotech crops." This followed a suite of biosafety laws and regulations designed to make Malawi "ready to progress" with GM crop trials. Unlike its Zambian and Zimbabwean neighbors, the GOM has always had a permissive approach to GM crops, accepting GM food aid from the US in 2000, with few restrictions, and introducing biosafety regulations in 2002 that were counter to the precautionary approach adopted by many other African countries

(Mayet, 2004). As we later describe, this approach aligned closely to policies of liberalization adopted by the Malawian State, and had the heavy influence of external actors, such as AGRA.

GM crop adoption in South Africa

Genetically modified crops first became prominent on the South African agricultural landscape in 1992, when the Apartheid government approved Monsanto's field trials for Bt insect-resistant transgenic cotton. At the time, there were no regulatory frameworks in place for these novel crops, which remained untested, and oversight was through a voluntary group of scientists, the South African Genetic Experimentation Committee, which had close ties to industries promoting the development and marketing of GM crops and seeds. Trade liberalization, accompanied by European reservations about genetically modified organisms (GMOs), led to immense pressure to commercialize new products and to open new markets in Africa (Wynberg, 2003; Bowman, 2015). South Africa, with its relatively sophisticated infrastructure and research capacity, provided an ideal launch pad to do so. A model evolved whereby multinational biotechnology companies—all with their origins in agrochemicals—typically financed research and partnered with local research facilities to develop and promote GM crops. This system laid a crucial foundation for the rapid adoption of GM crops in South Africa.

Faced with a plethora of new policy imperatives, the newly elected post-Apartheid government played a largely passive role in determining policy on genetic engineering. More pressing issues dominated the policy arena, allowing civil servants and those with vested interests to introduce laws and policies in more peripheral areas without following due process. One such law was the Genetically Modified Organisms Act 15 of 1997 (the GMO Act), promulgated *after* the first commercial planting of a GM crop in South Africa and without a comprehensive public participation process. Structures set up to implement the GMO Act similarly excluded public-interest groups, but access to the state by major seed companies continued, often through industry-funded public science that actively promoted genetic modification.

With increased lobbying from seed companies, a flood of permit applications for GM crop plantings, and the need for South Africa to engage in international negotiations for a biosafety protocol under the UN Convention on Biological Diversity, the stance of the government in regulating GM crops soon shifted from one of "convenient neglect" toward one representing all the characteristics of a country strongly promotional of their uptake (Paarlberg, 2000). This reflected the strongly pro-business stance of the African National Congress (ANC) government, which had come to power not only with immense popular support but also with substantial backing from large capital (Sitars, 2010; Marais, 2011; Du Toit, 2022). Although this capital was not necessarily linked to companies promoting GM crops, it indicated the post-Apartheid government's accommodating position regarding business engagement in policy formulation and decision-making (Du Toit, 2022).

South Africa is today a country well-known for its highly promotional approach to GM crops. With 2.7 million hectares of the country's land currently under cultivation to GM maize (an estimated 2.17 million ha, equaling 85% of the country's production), soybean (494,000 ha, 90%–100% of production), and cotton (9,000 ha, 100% of production), it constitutes the largest area devoted to GM crops in Africa and the ninth largest in the world (ISAAA, 2018). White maize comprises about 58% of this amount, produced as a food staple, while yellow maize constitutes about 42%, produced largely for animal feed (Masehela et al., 2021). Since 2017, both the production of GM maize and the area it covers in South Africa have remained relatively constant, with some variability due to climatic conditions and related drought (gm.agbioinvestor.com; Biosafety South Africa, personal communication, 11/10/2023).

Since the commercialization of the first GM crop in South Africa in 1995, a total of 27 general release permits have been granted for commercial planting in the country, with 10 GM crops granted trial approval (Masehela et al., 2021). GM crops developed and approved for field trials have included sugarcane, potato, canola, cassava, wheat, grapevine, and groundnut. As in the rest of the world, almost all field trials and commercial releases comprise mainly 2 traits—tolerance to herbicides and pest resistance through incorporation of genes from Bt. Stacked traits, which combine two or more genes of interest into a single plant, are increasingly incorporated into GM seed, particularly maize (Mawasha, 2020).

The past 30 years of GM adoption in South Africa have revealed sharp differences in their uptake and impacts, reflecting the country's dual agrarian structure, which comprises both large-scale commercial farms, typically under white ownership, and small-scale subsistence farms, concentrated in the former communal "homelands" where the majority of black South Africans were forced to live under Apartheid laws. While the Apartheid legacy of this dualized system is unique to South Africa, the colonial shaping of its agricultural landscape is similar to many other countries in the Global South, including Malawi, especially with regard to historical patterns of maize industrialization and modernization and the marginalization of smallholder farmers (Bernstein, 1996). In many ways, South Africa thus embodies the development paradigm forecast for the rest of the continent.

A sharp division exists between technologically advanced and capital-intensive, large-scale agriculture in former white areas (on 85% of agricultural land), and marginalized, smallholder subsistence farming in the remaining 15% of (generally poor) agricultural land by approximately 2.4 million smallholder farmers (Greenberg, 2013). In practice, both types of farming systems co-occur, sometimes adjacent to one another in the same region. Large-scale commercial farming typically produces commodity crops for local markets or export, while smallholder farmers produce largely for subsistence and local and domestic markets (Aliber and Hart, 2009; Greenberg, 2013). In each system maize is a key crop but is farmed with entirely different objectives, markets, values, cultivation methods, and meanings (Marshak et al., 2021).

On commercial farms, maize is produced industrially as a commodity crop for food, feed, and export, with high levels of fertilizer, herbicide, and pesticide inputs. In contrast, for many smallholder subsistence farmers, maize is viewed as the "pillar of the household" and is valued *inter alia* as a staple food, for the variety of ways in which it can be prepared, for its taste and resistance to drought, pest, and diseases, and for the strong traditions and customs that accompany the crop (van Niekerk and Wynberg, 2017). Although not indigenous to the region, maize has become embedded in farming systems and cultures across southern Africa over several centuries, replacing, or displacing, traditional staples such as sorghum or millet, but also assimilating within existing seed systems and being passed down from generation to generation (McCann, 2009; van Niekerk and Wynberg, 2017).

Smallholders typically grow maize as a primary staple crop, with many farmers reliant on open-pollinated varieties (OPVs) and/or local varieties, although hybrid and GM seeds are also planted. In addition to affordability, crop choices are often influenced by the successes and failures of fellow farmers and neighbors, which in turn are strongly dependent on the type of agricultural advice received. Over the past 30 years, the much-depleted state extension support services increasingly have been replaced by multinational seed companies and agro-dealers, which, except for a few NGOs, are the *de facto* sources of agricultural advice for many farmers, especially large-scale producers (Fischer and Hadju, 2015; Mahlase, 2017).

Estimates of the number of smallholders that have adopted GM crops in South Africa are difficult to calculate due to the limited availability of smallholder data, the diverse categorizations of smallholder farmers, and the aggregation of seed sale data (Gouse et al., 2016). What is clear, however, is that the uptake has been extremely low. Gouse et al. (2008 in Gouse et al., 2016) estimated that in 2008 approximately 10,500 smallholder farmers in South Africa planted GM maize, comprising less than 0.5% of the country's 2 million smallholder maize farmers.

The limited number of smallholder farmers who have taken up GM crops in South Africa typically were incentivized to do so through government and seed industry-sponsored campaigns, designed and implemented to promote the cultivation of GM cotton and maize (Witt et al., 2006; Assefa and van den Berg, 2010; Gouse, 2012; Fischer and Hadju, 2015; Mahlase, 2017). Monsanto, for example, disseminated Bt insect-resistant maize to smallholder farmers via their "Seeds of Success" program, which at first distributed free GM seed in a package alongside fertilizers and herbicides (Gouse et al., 2016). Modeled on a "lead farmer" approach, where individual farmers are trained and targeted to train other farmers and accelerate the uptake of technologies, and through government-supported maize development projects such as the Massive Food Production Program, smallholders were similarly supplied with free or subsidized Bt maize and fertilizer (Gouse et al., 2005; Jacobson, 2013; Jacobson and Myhr, 2013; Fischer and Hajdu, 2015; Mahlase, 2017). Over time, most, if not all, of these projects have collapsed, especially as subsidies were withdrawn and farmer debt increased due to input costs, but GM seed retains an unintentional presence in many smallholder fields in South Africa.

GM contamination in smallholder agriculture in South Africa: Why it matters

The low level of GM maize adoption among smallholder farmers in South Africa, due both to its high costs and the extent to which it meets smallholder needs, belies the extent to which their crops and farming systems are affected by GM seed. Maize is a wind-pollinated outcrossing plant with no known biological barriers to gene flow within the *Zea mays* species complex (Ellstrand and Hoffman, 1990; Ellstrand et al., 1999; Quist and Chapela, 2001; Johnston et al., 2004; Aheto et al., 2013). Therefore, gene exchange between all types of maize is common, a fact that underpins the widely recorded outcrossing and spread of transgenic traits into the seed of non-GM OPVs and landraces in South Africa (Jacobson and Myhr, 2013; Iversen et al., 2014).

This contamination occurs through several pathways (Bøhn et al., 2016; Schnurr, 2019), all usually beyond the farmers' knowledge and capacity to detect: pollen flowing between adjacent GM and non-GM maize fields, seed recycling and sharing, the sale of incorrectly labeled seed, and the distribution of "free" or subsidized seed by government agencies and seed companies (Iversen et al., 2014; Price and Cotter, 2014; Kganyago, 2020) (see **Figure 1**). Combined, these events facilitate and accelerate the flow of transgenic material along a multitude of pathways to non-GM varieties and present serious barriers for farmers who wish to maintain the use of local varieties and grow a diverse mixture of non-GM maize and other crop varieties.

Pollen flow between maize fields is a major source of contamination in both smallholder fields and industrial plantations, despite requirements for farmers to plant a so-called "refuge" area of non-Bt maize alongside their Bt crop in order to delay the widely documented resistance to stem-borer (e.g., Tabashnik et al., 2013; Tabashnik and Carrière, 2019). A study involving 105 commercial farmers farming 87,778 hectares of maize in the main highveld maize production region of South Africa revealed that 99.8% of farmers allowed no spatial separation between the Bt field and the required buffer (Kruger et al., 2012). Unsurprisingly, low levels of compliance are also evident among South African smallholders, where small fields, combined with low levels of awareness, make refuge requirements near impossible to achieve (Assefa and van den Berg, 2010; Jacobson and Myhr, 2013; van den Berg et al., 2013). High levels of pollen flow between fields are thus inevitable, especially in contexts where small-scale subsistence and large-scale commercial farmers exist alongside one another (Kganyago, 2020). For example, as Kganyago (2020) describes, the vast, industrialized maize monoscapes that characterize the North West province are a world apart from the diverse cropping

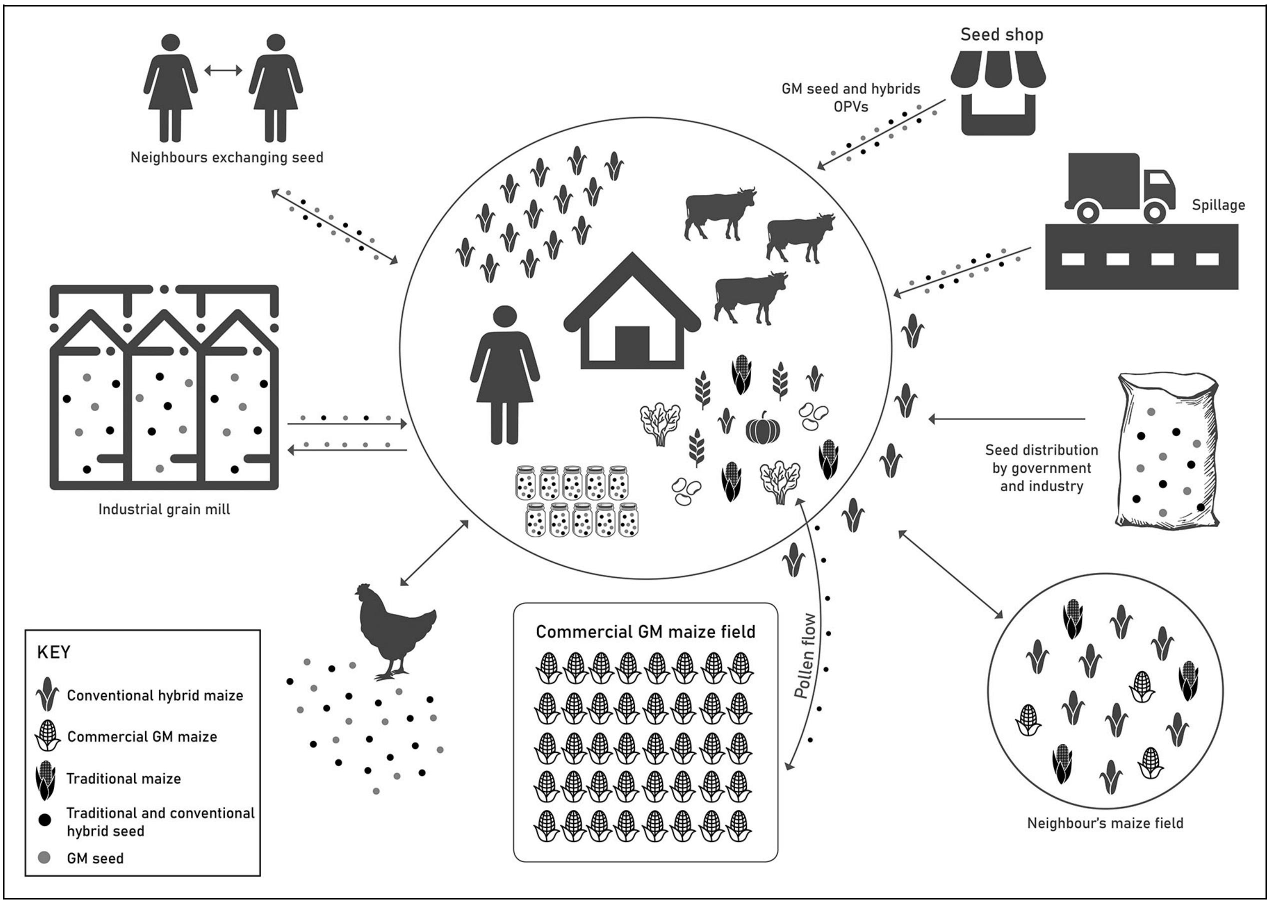

Figure 1. Pathways for the contamination of local seed systems by GM seed. Source: Wynberg and Hilbeck (2024).

systems farmed by smallholders in the small North West village of Sespond. While Sespond villagers may not grow GM maize, their farms are located adjacent to industrial GM plantations in a complex agricultural landscape and their traditional and OPVs of maize will almost inevitably be exposed to transgene flow.

The prevalence of seed recycling, sharing, and replanting among smallholder farmers provides a further avenue for contamination. Research across several South African provinces, in Kwazulu-Natal (Mahlase, 2017; Marshak et al., 2021), the North West (Kganyago, 2020), and the Eastern Cape (Iversen et al., 2014), has revealed how small-scale farmers are not able to detect different maize varieties in their seed systems, with farmers often unsure of the cultivar, the seed company, and whether the seed is OPV, conventional hybrid or GM. Remarked one farmer in Kganyago's (2020) study: "In the olden days when we only knew the seeds our fathers grew in their fields, we understood where the seeds came from and how they adapted to the environment." Locally recycled maize varieties often intermingle with GM maize seed that is unknowingly accepted as a gift from families and friends, reused from chicken feed, acquired from agro-dealers with unclear or incorrect information, or donated through government subsidy programs (Iversen et al., 2014; Witt, 2018). Combined, these diverse pathways of contamination accelerate the flow of transgenic material to non-GM varieties, while breaching the biosafety requirements indicated in the approval and licensing conditions of GM crops. They also confirm the problems of applying management measures designed for large-scale commercial farming to small-scale, subsistence agriculture, given their very different agronomic practices, cultural contexts, and levels of awareness about GM crops and their management.

Transgenic contamination has profound implications for both smallholders and the farming systems that they nurture. In addition to impacts of introgression on agrobiodiversity, food security, and farming practices such as seed saving and seed selection, contamination undermines the centrality of traditional seed storage and exchange systems. These systems not only maintain and enrich crop genetic diversity and social cohesion but also increase the resilience and autonomy of small-scale farmers through reducing their dependence on commercial seed (Kloppenburg, 2010; Helicke, 2015; McGuire and Sperling, 2016). Such violations raise questions about the laws designed to protect farmers from transgene contamination, including liability for unintended contamination and its legal consequences. Despite a strong articulation of the right to food in the South African Constitution, small-scale farmers are situated in an uncomfortable legal space which has been strongly promotional of industrial agriculture and the interests of the commercial seed sector, while neglecting the rights of small-scale farmers to save and plant seeds of their choice (Wynberg et al., 2012). Such rights extend also to the consumption of traditional maize. Kganyago (2020) explains how a lack of local milling and storage facilities led small-scale farmers to send their traditional maize harvest to an adjacent mill for both processing and storage. Although farmers consciously chose to plant traditional maize because of its preferred taste and nutritional qualities, the lack of separation facilities at the mill meant that the processed maize flour (*bupi*) they received back was not what they had planted and was perceived to be of an inferior quality. Similarly, while farmers received back a similar volume of stored seed from the mill to that which they had deposited, it was typically not the traditional maize they had originally sent for storage, which opened up yet another pathway for contamination of their seed.

In a 4-day "caravan" of farmers, NGOs, scientists, and gene-bank managers that traversed KwaZulu-Natal in 2018 to explore these issues, agroecological farmers who were reviving their traditional varieties and actively avoiding GM maize, spoke of the deep trauma they experienced when learning that their maize had tested positive for GM proteins. Some pronounced that they would "tear up their fields," while others felt affronted that their right to plant and eat traditional maize had been obliterated through contamination. Such sentiments are not, however, confined to farmers who intentionally avoid GM crops and pursue an agroecological approach to farming. Farmers in Sespond, for example, grew a mix of GM, open-pollinated, and traditional maize varieties and intentionally planted these crops in different areas of their fields, for different purposes. The contamination of their traditional seed, passed down for generations, left them feeling despondent, ignorant, and insecure (Kganyago, 2020).

Despite the paucity of research on this topic, the deep connections between traditional seed systems and culture are well-known (van Niekerk and Wynberg, 2017), and the contamination of traditional seed is likely to have significant effects on local farming systems and on farmer psychology, well-being, and morale. Moreover, as farmers lose touch with the qualities of the seed they are planting, seed becomes anonymous, and patterns of seed and knowledges disintegrate. As Marshak et al. (2021) describe, farmers may perceive their own knowledge to be inadequate, leading to the loss of socio-ecological agency and farmer disempowerment.

More insidious impacts are also possible. For example, the occurrence of introgressed GM traits in OPVs or landraces grown in small-scale farming systems may lead to farmers unknowingly or accidentally selecting the Bt trait in their maize varieties (Wynberg and Hilbeck, 2024). This may have unpredictable consequences for the genetic diversity of their seeds (see also Lohn et al., 2020). Thus, knowledge about the dynamics of transgene flow and the seed selection behavior of farmers is of fundamental importance for small-scale farmers who prefer to cultivate and select GM-free OPVs and/or landraces.

There is also a risk of transborder transgene flow, given that South Africa currently stands alone as a producer of GM crops in the southern African region. Indeed, many GM farming activities straddle the borders of South Africa and Eswatini, Lesotho, Zimbabwe, and Mozambique. This is likely to have multiple socio-ecological, economic, and transborder cultural political implications for affected smallholder communities. We now consider the implications that the South African case might have for Malawi.

History and political economy of Malawian agriculture

Malawi is an interesting case to examine the implications of GM crops, in part because it is a country where most people live in rural areas and rely on agriculture as their main livelihood and food supply. Maize dominates landscapes and diets, making up over 60% of calories consumed and land in production (Chinsinga and Poulton, 2014). Agriculture employs about 80% of the population and contributes to over 90% of the country's export earnings and about 30% of its GDP (World Bank, 2022). There is a growing divide between an urban political elite, and a rural agrarian populace (Gabay, 2015). About half of the population lives in poverty, and one-quarter lives in extreme poverty, with growing rates of rural poverty and declining urban poverty rates (World Bank, 2022). As such, the politics surrounding agricultural policies and the key actors shaping those agrarian politics play a large role in influencing the broader political economy (Chinsinga, 2011).

Malawian smallholder farmers grow mixed crops on an average of 1.2 hectares, with maize making up an estimated 3-quarters of crop landscapes, combined with grain legumes (e.g., beans, peanuts, pigeon pea), tobacco, and some tubers (e.g., sweet potatoes, cassava). While the cropping system was diverse and intercropped in the precolonial era, including indigenous cereals such as sorghum and millet (Vaughan, 1987; Mandala, 2005; Bezner Kerr, 2014), the current cropping system holds maize as king, making up over 90% of cereal produced between 1961 and 2017 (Jakobsen and Westengen, 2022). Smallholders typically grow a mixture of local OPVs and hybrid maize varieties, storing the hard-grained OPVs for consumption and often using hybrid varieties for postharvest sales (Bezner Kerr, 2013). A recent large-scale survey found that hybrid maize made up 61% of maize grown in Malawi with the remainder made up of local OPVs (Westengen et al., 2019).

There are 3 GM crops currently being tested or scaled out in Malawi: virus-resistant banana and Bt cowpea, which are both under research trials, and Bt cotton which has been released for commercial use (The Mbio Project, 2023). The implications of commercially releasing GM crops in Malawi build on a long history of promoting hybrids (Chirwa, 2005), and perpetuate a model of agriculture that is both dismissive of local knowledge and agrobiodiversity, and is mismatched to the needs of millions of smallholders in the country that produce food for their families. As Schnurr and Dowd-Uribe (2021) describe, these technologies, at least in their current first-generation form, are poorly suited to African smallholder systems and their "lofty projected benefits" are unlikely to be realized by most smallholder farmers, due in part to annual input costs required for these crops which are unaffordable for most smallholder farmers.

Moreover, through transgene flow—the contamination by GM traits of non-GM varieties of the same crop—they also pose direct threats to the diverse, nutritious, and resilient seeds that have been nurtured over generations and form the food basis for most smallholder families in Malawi. A growing body of research is revealing that transgene flow is widespread, even in remote situations previously thought to be impervious to cross-contamination (Quist and Chapela, 2001; Fitting, 2011; Bøhn et. al., 2016; Fernandes et al., 2022), with implications for maintaining traditional landrace varieties, and cultural foodways associated with them (Fitting, 2011).

Local OPV maize in Malawi has persisted despite active state promotion of hybrid maize over many decades, although unintended GM contamination could well change this situation. During the post-World War II period, maize monoculture and fertilizer use was promoted using the "Master Farmer" approach that emphasized "expert" farmers teaching others modern farming methods (Kalinga, 1993). President Hastings Banda, who ruled as authoritarian dictator (1964–1994) in the post-colonial period, supported an elite group of farmers called *achikumbe* who had greater access to extension and production inputs (Tauzie et al., 2023). Banda also augmented and reinforced notions of "modern" agriculture as intimately tied to hybrid maize, fertilizer, and monocrops, actively discouraging local crop varieties and intercropping (Bezner Kerr, 2014). Fertilizer subsidies, combined with the establishment of the National Seed Company of Malawi, and rural depots of the Agricultural Development and Rural Marketing Corporation (ADMARC) throughout the country, provided stable supplies of seed to rural areas (mainly tobacco, maize, groundnuts, and a few other key crops). Smallholder farmers had to sell to these depots, first through the colonial Marketing of Native Produce Ordinance in 1935 and then through the Farmers Marketing Board in 1950 (Kalinga, 1993), but the maize price was fixed at a relatively high price (Harrigan, 2003). This system ensured the steady increase of hybrid maize production and reliance on fertilizer. At the same time, industrial approaches to agriculture were heavily promoted through notions of modernity, with the regime taking an active interest in maintaining control over rural populations through agricultural extension, including Banda holding annual "First Farmer" field days with fiery speeches encouraging farmers to plant more maize and become "modern" farmers (Bezner Kerr, 2014). Notably, these policies and programs promoting industrial agriculture were enacted under an authoritarian regime that restricted free speech, increased political control over the media, and other forms of political repression (Jones and Manda, 2006) thereby restricting rural peoples' ability to counter government edicts on agriculture.

The transition to democratic rule in the late 1980s to 1990s coincided with a debt and fiscal crisis and neoliberal policies (Chinsinga and Poulton, 2014). The stipulations of the World Bank and the IMF for structural adjustment loans, currency devaluation, and removal of fertilizer and seed subsidies had dramatic impacts on smallholder production (Smale and Phiri, 1998; Harrigan, 2003). ADMARC depots, agricultural extension, and other public expenditures were all reduced, alongside agricultural credit (Mvula et al., 2003). Maize production fell, fertilizer prices rose dramatically, and smallholder income levels fell by an estimated 25% while estate incomes rose by 44% during this period (Sahn and Arulpragasam, 1991; Ellis et al., 2003; Bryceson and Fonseca, 2006). These policies led to a highly vulnerable rural population, which experienced chronic food shortages and increased dependence on food aid and commercial imports in a country which had once been nationally food self-sufficient (Chinsinga, 2004). There was also a rising dependence on foreign aid, and related influence of foreign donors in shaping national policy (Smale and Jayne, 2003; Gabay, 2015). In the 1980s and 1990s, neoliberal policies of liberalization also allowed the increase of estates.[1] Agricultural estates grow export crops, mainly tobacco, maize, groundnuts, and tea, using industrial production methods, and today control about 25% of arable land in Malawi, with land sizes on average 39.8 hectares (Deininger and Xia, 2018). While the plantation sector is notably smaller than the South African case, the focus on commercial crops means that increased industrial production of GM maize can be anticipated in these estates, with related concerns for contamination of neighboring smallholder plots.

Seeds and fertilizer subsidy programs

Liberalization, as part of structural adjustment, included the sale of the National Seed Company of Malawi to Cargill in 1990, and then in 1998 to Monsanto (now Bayer), along with the entry of other multinational agro-input companies. These changes ushered in a neoliberal era in which multinational agro-input companies became major beneficiaries of these public policies (Chinsinga, 2011; Jakobsen and Westengen, 2022). Foreign agricultural investment was facilitated further with Malawi becoming signatory to the New Alliance for Food Security and Nutrition (NAFSN) in 2012, which committed the Malawian government to promoting private sector agricultural investment in the country (Westengen et al., 2019). Agricultural extension was dramatically reduced during the 1990s and 2000s, contributing an estimated 1.6% of agricultural spending in 2012/2013, compared to the agricultural input subsidy program making up 44% of agricultural spending (Ragasa and Mazunda, 2018, p. 26). A "lead farmers" policy was introduced in 2009, that aimed for farmer leaders to act as a bridge to support extension workers' promotion of technology adoption, but only reached an estimated 13% of farmers nationally (Ragasa, 2020).

Financial mismanagement and high levels of corruption by the first democratic president, Bakili Muluzi, further

1. The Land Act of 2016 categorized all land in Malawi as either public (government or unallocated customary land) or private (freehold, leasehold, and "customary estates"). Customary estates are defined as private land owned, held, or occupied in a traditional land management area (Deininger and Xia, 2018, p. 283).

exacerbated rural vulnerabilities, with rampant inflation and high deficits (Chirwa and Dorward, 2014). Muluzi, who drew political patronage from the commercial business elite, turned to maize production as a source of political support through the Starter Pack Programme, which involved distribution of fertilizer and hybrid maize seed to over 3 million smallholders, with the support of key donors such as the US government (Chinsinga and Poulton, 2014; Chirwa and Dorward, 2014). Downsized to the "Targeted Input Programme," it served as a source of political patronage and further promoted input use and maize production for rural households (Chirwa and Dorward, 2014). The sale of the Strategic Grain Reserve, combined with transportation challenges, communication mishaps, drought, and slow donor response to requests for food aid, led to a severe famine in 2002, affecting over 3 million people (Devereux, 2002; Chinsinga and Poulton, 2014). The Biosafety Act was passed during this politically charged time, allowing for importation of GM food aid from the United States, in dramatic contrast to neighboring Zambia (Mayet, 2004). The Act was passed with support from the Southern Africa Regional Biotechnology Program (SARB), a sub-project of Michigan State University funded by USAID and with sector partners including Monsanto and Pioneer Hi-Bred (Mayet, 2004). The SARB objective was to provide a "regulatory foundation to support field testing of genetically engineered products" (Mayet, 2004). The Biosafety Act does not provide any regulations with regard to risk assessment, monitoring, or any other environmental or health provisions, with the main requirement for parties interested in growing or importing GM crops being the obtaining of a special permit from the Minister (Mayet, 2004).

Agriculture and food policy throughout this time became an increasing source of political contention both within national politics and between foreign donors and the Malawi government (Chirwa and Dorward, 2014). It was in this highly politically sensitive context that the Farm Input Subsidy Program (FISP), now called the Agricultural Inputs Programme (AIP), was launched, first implemented in 2006 under President Bingu Mutharika. The program provides coupons to an estimated 50% of Malawian farmers in any given year, which allow them to purchase 50–100 kg of synthetic fertilizer, 5–8 kg of hybrid maize, and other seeds at significantly reduced rates—ranging between 45% and 97% each year (Chirwa and Dorward, 2014; Jakobsen and Westengen, 2022). The program was hailed internationally as a solution to food insecurity and the dawn of a new African Green Revolution (Denning et al., 2009). Subsequent subsidy programs in other African nations followed Malawi's example (Jayne and Rashid, 2013). While the FISP initially increased national maize production, signaling an impressive break from 2 decades of chronic food insecurity (Chinsinga and Poulton, 2014), in subsequent years the outcomes were more variable, with evidence of overestimation of maize yields for political reasons (Chinsinga, 2012; Chirwa and Dorward, 2014; Messina et al., 2017). There is evidence that the subsidy has increased food security and nutrition for recipients (Harou, 2018; Hodjo et al., 2021) but had lower than expected crop yield response on smallholder farms (Jayne et al., 2018). There has been persistent evidence that the subsidy program benefits large-scale, better-off, and more politically networked farmers more than lower income smallholder farmers, with the subsidy used to gain political support (Chinsinga and Poulton, 2014). Given persistently high rates of poverty, food insecurity and malnutrition, debates remain about the benefit–cost ratio, and whether the funds could be more effectively used to address smallholder livelihoods, sustainable land management, and food security through integrated programs that could include legume intercrops, small livestock, agroforestry, irrigation infrastructure, school feeding programs, and social protection (Jayne et al., 2018; Bizikova et al., 2022; FAO et al., 2022).

The input subsidy program has proven to be a stalwart friend of the party in power, prone to political manipulation, and a key tool in bolstering rural support for the governing party (Chinsinga, 2012; Chinsinga and Poulton, 2014). Several studies have found a strong association between support for the ruling party and receipt of coupons (Holden and Lunduka, 2013; Jayne et al., 2013). Local politics are also at play with "fertilizer politics," with evidence of retailers insisting on bribes, field staff creating "ghost" families to obtain and sell coupons, and other types of fraud reported (Chinsinga, 2009; Chirwa and Dorward, 2014). The seed for AIP is mainly supplied by large multinational companies (Bayer/Monsanto, Chem China/Syngenta, Pannar, Seed Co., and Pioneer Hi-Bred, now part of Corteva Agriscience), which increases their influence over agrarian politics (Jakobsen and Westengen, 2022). In addition, political economic analysis points to the role of donors in shaping agricultural policies in Malawi (Nkhoma, 2019).

Crop diversity and seed politics

Agrobiodiversity declined in Malawi in the first decade of this century, from 3.08 crops per farm in 2004/2005 down to 2.33 crops per farm in 2010/2011 (Kankwamba et al., 2018). The initial decline after the introduction of the AIP was due in part to a strong budgetary allocation toward maize production in the program (Kankwamba et al., 2018). While the government has consistently touted crop diversification as a strategy, increasingly citing it as a key to build climate change resilience, the focus on maize production as a key to maintaining political stability undermined any diversification policies or messages (Chinsinga et al., 2011; Kankwamba et al., 2018). In the last decade crop diversity has increased, with the most recent national assessment in 2019 reporting 4.88 crops per farm (Makate et al., 2023). A recent study suggests that crop diversification has increased in part due to farmers' response to rainfall shocks (Makate et al., 2023), and it may be that more emphasis on crop diversity in government and nongovernmental programs is having an impact. There is, however, evidence that maize varietal diversity, particularly the use of OPVs, which make up only 6% of seeds sold through the subsidy program (Chirwa et al., 2016), has declined at least in part due to the subsidy program (Chinsinga et al., 2011; Bezner Kerr, 2013;

Westengen et al., 2019). This decline in maize varietal diversity has implications for agroecology and is linked to national level efforts at harmonizing seed policies, as we will discuss next.

A National Seed Policy was launched in 2018, with the overall goal stated as "to provide clear guidelines for the development and promotion of the seed industry in order to raise agricultural productivity through the provision of sustainable, adequate and high-quality seeds" (Ministry of Agriculture, Irrigation and Water Development, 2018). The neoliberal emphasis on the commercial seed sector as a key strategy for addressing agricultural productivity is evident in this policy (Westengen et al., 2019). Meanwhile, a draft Seed Act was published in 2015 with reported input from the seed industry (Wise, 2017); it received considerable criticism from civil society (Chinsinga and Bezner Kerr, 2016; Westengen et al., 2019). The final Act prepared by the Ministry of Agriculture was published on March 30, 2022, and was passed 5 days later, on April 4, 2022, contrary to Standing Order Parliamentary Rule 157, which requires at least 28 days before the first reading in Parliament. There was thus no time for public consultation. Notably, AGRA, in the lead up to the Act, funded the Civil Society Agriculture Network (CISANET), an umbrella organization, which controversially supported the Act. Staff later admitted that the funding that they received from AGRA was a conflict of interest and put pressure on CISANET to support the Act, despite member organizations' objections (CISANET staff person, personal communication, 05/01/2023).

The Act has a primary focus on certified, registered varieties, with an overall goal "to regulate the release and registration of crop varieties in Malawi; regulate the production, processing, certification and sale of certified seed and importation and exportation of seed" (GOM, 2022, p. 1). Included in the Act are provisions for seed inspection and testing, registration of seed producers and sellers, certification, varietal release, and offenses and penalties. The policy document is explicit in promoting the commercial seed industry interests, formalizing the role of the private seed sector in multiplication and marketing of scientifically tested genetic seed sources, and protecting breeder's rights. The quality control and seed trade is to be done through a government-driven legislative and regulatory framework as stated in the Act. Thus, the Seed Act provides a strong legitimacy to the private seed industry and the role of the government itself in the seed sector. The priority as outlined in the Act is to set up a new Seed Regulatory Authority that will give the necessary control for Government agencies to regulate the seed sector through institutional, regulatory, and legal frameworks that support the efficient functioning of the seed industry.

The Seed Act remains silent about farmers' seed systems, the role of local communities and farmers in preserving and maintaining seed and agrobiodiversity, and Farmers' Rights. There is no acknowledgment about the importance of agrobiodiversity or the rights of farmers to save, exchange, reuse, or sell farm saved seed. In fact, the word "farmer" appears only twice in the policy document, once with regard to providing quality seed to farmers, and once with regard to a committee. Article 22 of the Act indicates that a Crop Variety Release and Registration Committee will be established with 7 members, including one member selected by farmers' organizations. The selection or mode of appointment of the farmer representative is not specified in the Act and it is debatable whether this representative will be able to adequately speak on behalf of and protect the rights of Malawian farmers. Other key decision-making bodies named in the Act, namely the Seed Regulatory Authority (Section 5) and the Appeals Panel (Section 49), have no farmer representatives.

Article 26 states that "The Authority shall maintain a database of local crop varieties and such other crop varieties as the Minister may prescribe by notice published in the Gazette." Nothing more is stated about the role of the database, and how farmers who produce these varieties will be affected by the database. The GOM ratified the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in 2006 and, as a Party to the Treaty, has committed to recognizing and implementing the rights of farmers to save, use, sell, and exchange farm saved seed. Despite several seed policies, such as the National Seed Policy and the Plant Breeders' Rights Act, there is no legislation that specifically addresses farmers' seed systems or recognizes and protects farmers' rights with regards to seeds.

While the Act renders farmers' seed systems invisible, it explicitly names GM crops as 2 of the 4 recognized types of certified seed, Malawi Certified Genetically Modified Seed and Imported Certified Genetically Modified Seed. Previous legislation, the Biosafety Act 2002 (amended in 2007) only allows the use of GMOs under special arrangement for scientific research or food provision. Specifically, the Biosafety Act states "no person shall engage in the genetic modification of organisms; and importation, development, production, testing, release, use and application of GMOs," so the 2022 Seed Act appears to contradict this Act, paving the way for the sale and use of GM seeds in Malawi. What will this mean for agrobiodiversity in Malawi?

The social and ecological configuration of South African farming systems, which enhances the likelihood of GM seed contamination (**Figure 1**) mirrors many of the qualities which could facilitate GM contamination in Malawi. Smallholder farmers have small fields, often adjacent to large estates, and are not able to maintain wide boundaries to prevent pollen flow. The majority of farmers recycle their own seed and share seed with neighbors and family members (Bezner Kerr, 2013; Vansant et al., 2022). A subsidized seed distribution program with high levels of influence from multinational seed companies enhances the likelihood of GM seed distribution by both government and seed company activity in the country. The ongoing influence of funders such as AGRA in strategic policymaking increases this likelihood.

In addition, local maize landraces, which have been maintained for centuries in Malawi, play an important cultural role, providing the mainstay of the staple cuisine. These hardy flint varieties are more easily kept in smallholder grain stores, are better able to withstand weevils, and produce greater quantities of flour when pounded (Smale, 1995; Jakobsen and Westengen, 2022; Vassant et al., 2022). Farmers are aware that local landraces cross-pollinate with hybrid varieties, and some have expressed concern about the decline in quality traits for their traditional varieties due to this mixing, as part of a general sense that local agrarian knowledge and cultural practices are on the decline (Bezner Kerr, 2013; Vansant et al., 2022). Persistent neocolonial narratives about the "backwardness" of traditional farming practices and varieties can reinforce farmers' feelings of inferiority about their landrace varieties in relation to the commercial seed sector (Jakobsen and Westengen, 2022). Frequent floods and droughts experienced in Malawi in recent years have increased narratives about climate change as a reason to switch to hybrid varieties, touted by government and the private sector as more climate resilient (Westengen et al., 2019). All of these factors play into a heightened risk of GM contamination with subsequent further reduction of agrobiodiversity and seed sovereignty for Malawian smallholders.

Nonetheless, there is a growing resistance to this narrative and to the push to rely solely on commercial seed varieties. In 2022 after the Seed Act was passed, non-governmental organizations and grassroots organizations that promote agroecology, permaculture, and food sovereignty organized a Seed Fair in direct response to the Seed Act in which they not only displayed the diverse range of landraces but advocated for farmers' rights to be recognized and local seed varieties to be respected and acknowledged. At the time of writing, there is a notable effort to pass a Farmers Seed Act which is gaining momentum in Malawi, with support from these organizations and networks.

Discussion and conclusion

This article set out to explore what the combined history of hybrid and GM maize adoption in smallholder farming systems in South Africa could tell us about the implications for smallholder Malawian farmers of the likely use and spread of GM crops. Using political ecology approaches, and a conceptual framework that draws on the intersections of food and seed sovereignty, agroecology, and coloniality, we describe the histories and political economies of how maize and its associated technologies and inputs were commodified in South Africa and Malawi. We demonstrate how ongoing colonialities and power relations continue to repress smallholder farmers and denigrate their agroecological knowledges, leading to a loss of dignity and self-worth, and a disintegration of the relationship between people and nature. Drawing on these experiences, we consider what reimagined, transformed, and decolonial approaches for food and agriculture might look like on the African continent. **Table 1** provides a summary of some of the key features that characterize the ongoing coloniality of food and agriculture in Africa, alongside a counter-narrative of decoloniality that advances alternative imaginaries for the continent.

Our analysis reveals that despite divergent politics, histories, and very different social, economic, and ecological contexts, the trajectories of agriculture in South Africa and Malawi are astonishingly similar. Both countries are characterized by a state that has become increasingly seduced by (largely foreign) capital, with public monies used to cross-subsidize multinational food and seed corporations and their associated Green Revolution complex of hybrid seed and agrochemical inputs. These colonialities of power are expressed, *inter alia*, through entrenched inequities in decision-making on seed-related policies which privilege corporate power, while ignoring the needs of smallholder farmers.

Ongoing colonialities of knowledge are reflected in the dominance of Western, scientific knowledge, characterized by technological adoption strategies that give prominence to "expert" knowledge, such as the Master Farmer or in the contemporary period, Lead Farmer, while the lived, experiential knowledge held by small-scale African farmers is ignored, belittled, suppressed, or made invisible. In both countries, for example, agricultural research was, and remains, driven by colonial and external forces, with a focus on export crops that are not relevant for most small-scale farmers in these countries. Commodity maize is thus king, with a single-minded focus on maximum yields, at the expense of nutritional needs, local preferences or indigenous crops, and the exclusion of local agroecological knowledges (Buhler et al., 2002; Wynberg et al., 2018).

Such rendering reinforces racialized notions of agrarian realities and undermines African cultures and ontologies. Experiences in both Malawi and South Africa reveal how peoples' agency and right to food has been undermined, by emphasizing farming systems which fail to support dignified livelihoods and foodways for rural communities and, in the case of South Africa, through the introduction of GM crops, and the physical and psychological effects this has had on seed saving, planting, storage, and exchange. As the experiences in South Africa reveal, the promotion of GM maize and associated transgene flows presents serious barriers for farmers who wish to maintain the use of diverse, local varieties and raises questions relating to farmers' rights to choose what they plant and eat, as well as impacts on agrobiodiversity, food security, and farming practices such as seed saving and seed selection. Lastly, by disconnecting people from nature, and from the land and life that sustains them, the "monocultures of the mind" (Shiva, 1993) that GM crops facilitate, perpetuate a vision of a "one-world-world," that separates nature from culture and which is only knowable through the application of science and technology (Law, 2015; Rosenow, 2019).

These combined experiences characterize what Ndlovu-Gatsheni (2015, p. 33) refers to as the colonialities of power, knowledge, and being: of power, through the ongoing domination by foreign capital; of knowledge, through the privileging of Eurocentric knowledge and ways of knowing above any others; and of being, by affecting peoples' agency and dignity. The rise of GM crops is an integral part of this long trajectory, with the commodity nature of maize, expressed through GM and hybrid varieties, effectively recolonizing traditional agricultural systems and perpetuating these colonialities.

Table 1. Coloniality and decoloniality dimensions of agriculture and food systems in South Africa and Malawi, along a continuum of Power, Knowledge, Being, and Nature characteristics

Coloniality	Decoloniality
Power	
Highly industrialized food, agriculture, and seed system based on export crops not relevant for most smallholder farmers and favoring those with access to capital, land, and other natural resources	Agroecologically based food and agriculture systems based on localized, decentralized production that addresses socio-cultural, food security, and nutritional needs of smallholder farmers and reduces dependency on external, synthetic inputs
Foreign influence and political patronage, philanthropic capital (e.g., AGRA) including subsidies to incentivize GM crop adoption	Redirects finance toward supporting agroecological practices and solutions
Inequities in policy- and decision-making that favor privileged corporate and elite commercial interests, both within and beyond country	Increases democratic control over food production Collective action through agroecology and food and seed sovereignty
Smallholder agriculture marginalized and denigrated	Affirms the right to save, breed, exchange, replant, and sell farmer-managed seed
Knowledge	
Expert-led (e.g., Model/Lead farmer) Industry-led research and knowledge toward private profit	Farmer- and experientially-led research and knowledge directed toward public benefit
Dominant system of scientific and high-tech knowledge	Recognizes multiple ways of knowing Affirms traditional knowledge-through farmer-led research and participatory breeding Protects traditional knowledge of seed saving and agriculture
Promotes the privatization of seed through intellectual property rights such as plant breeders' rights and patents. Criminalizes sale of farmer seed	Collective knowledge and community seed saving Supports open-pollinated, locally adapted varieties and rejects intellectual property rights
Being	
Undermines human right to food	Affirms human right to food
Traditional agriculture portrayed as "backward" and racialized	Supports traditional agriculture and restores connections to culture and land
Loss of dignity	Actively promotes self-worth and dignity through upholding rights and recognizing the value of traditional seed
Nature	
Disconnects people and nature through increased mechanization, contract farming, and a primary focus on yields and economic growth	Values relational approaches that recognize the entanglement of cultural and ecological dimensions of agriculture Shifts toward agroecological practices and "ecological reskilling"
Advances monocultures and loss of diversity	Conserves agrobiodiversity through maintaining locally adapted and diverse seed varieties
Worldview is that of the Universe and the "One World World"	Worldview is that of the Pluriverse and the multiplicities of existence

Source: Authors.

Alternative agrarian futures?

Despite these entrenched realities, new forms of resistance and future imaginaries are emerging. Although coalitions of international funding agencies, private foundations, African research scientists, and agribusiness corporations present a powerful dominant hegemony, there are opposing forces within Africa, including a grassroots food sovereignty movement that has grown since the 1990s and is well supported by many allies, including producer alliances, non-governmental and international organizations, scientists, donors, foundations, and social movements across continents (Rock, 2019; Boillat and Bottazzi, 2020; Madsen et al., 2021; Boillat et al., 2022; Swanby, 2024). These opposing forces promote agroecology, a holistic approach to agriculture which uses ecological processes while addressing health, social, political, and economic dimensions of the food system (HLPE, 2019).

In 2022, for example, as part of a campaign dubbed "Our Seeds, Our Rights, Our Lives," hundreds of small-scale farmers gathered across Southern Africa to affirm the rights they have to their traditional seed, knowledge, culture, land, and associated life systems. A foremost concern was the lack of a supportive national policy framework to recognize and support local seed systems and promote agrobiodiversity. Farmers strongly opposed laws that criminalize the sharing, marketing, and sale of traditional seed and called for an open market to sell traditional seed and crops. They requested governments to give "maximum support" to agroecology, provide critical rural infrastructure, and protect lands, livelihoods, and rights. Demands were made for technical and financial support for community and district seed banks. Farmers asked for support for farmer-to-farmer learnings, as well as farmer-led research training and extension services tailored to agroecology. A strong call was made to redirect funding toward agroecology from government subsidy programs that support fertilizers and other inputs. Farmers also expressed concern about the possible introduction of GM seed in Malawi, Zambia, and Zimbabwe.

Although not explicit, such sentiments provide the scaffolding for constructing an alternative imaginary for African food and agriculture systems that affirms a generative, decolonial agenda for reconfiguring the colonialities of power, knowledge, being, and nature. Establishing and supporting agroecological approaches as part of this architecture will require recognition of the entrenched political and financial interests which value GM crops and associated technologies built on expert knowledge and capital investment, and, crucially, will need finances to be redirected toward agroecological practices and solutions. It will also need renewed emphasis on the way in which food is produced and consumed, by removing blockages that prevent farmers from having control over their seed systems, supporting approaches that reduce dependencies on external, synthetic inputs, and enabling the inclusion of smallholder voices in policy development and decision-making.

Beyond recognizing unequal power relations, supporting an agenda that promotes food and seed sovereignty and agroecology will need active efforts to redirect knowledge about seed systems and agriculture. More inclusive and diverse ways of knowing that embrace and value farmers' innovations, and that pursue agricultural knowledge as a collective effort and public good rather than a tool for private profit will need to be strongly fore fronted. Decolonizing and reclaiming farmer seed systems will also require shifts toward more relational approaches that recognize the entanglements of cultural and ecological dimensions of agriculture and of how social-ecological relations shift in agricultural practices after the introduction of new types of seed (Marshak et al., 2021). Through bringing these elements together, in a conscious and incremental manner, small steps can be taken toward setting in place an inclusive, diverse, relationally robust, socially equitable, and ecologically secure future for African smallholders and the lands, diversity, and cultures of which they are custodian.

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