



“Whose demand?” The co-construction of markets, demand and gender in development-oriented crop breeding

Ida Arff Tarjem¹ · Ola Tveitereid Westengen¹ · Poul Wisborg¹ · Katharina Glaab¹

Accepted: 17 June 2022 / Published online: 27 July 2022
© The Author(s) 2022

Abstract

Advancing women’s empowerment and gender equality in agriculture is a recognised development goal, also within crop breeding. Increasingly, breeding teams are expected to use ‘market-based’ approaches to design more ‘demand-led’ and ‘gender-responsive’ crop varieties. Based on an institutional ethnography that includes high-profile development-oriented breeding initiatives, we unpack these terms using perspectives from political agronomy and feminist science and technology studies. By conceptualising the market as an ongoing, relational performance made up of discourses, practices and human and nonhuman actors, we trace how the market is understood as an effective socioeconomic institution for soliciting demand, but also becomes a normative agenda. Construed as a demand variable, the relational and structural dimensions of gender are rendered less visible, which might strengthen rather than transform power relations’ status quo. On the other hand, a feminist science and technology perspective broadens the field of vision not only to the gendered dimensions of crop breeding, but also to the nonhuman actors, such as the crops and traits falling outside the market sphere of interest. By putting political agronomy and feminist science and technology studies into conversation, the article contributes to the development of a feminist political agronomy.

Keywords Africa · CGIAR · Co-construction · Crop breeding · Demand · Feminist political agronomy · Gender · Markets

Abbreviations

CGIAR	CGIAR Consortium of International Agricultural Research Centers (formerly the Consultative Group on International Agricultural Research)
GBI	Gender and Breeding initiative
EiB	Excellence in Breeding platform
DLB	Demand-Led Breeding

Introduction

Advancing women’s empowerment and gender equality in agriculture is a recognised development goal, also within crop breeding. Concurrently, market-based approaches, founded on principles and methods adapted from commercial crop breeding, have become highly advocated in development-oriented crop breeding, especially in African countries, and strongly supported by private sector donors and political commitments and policies at the regional level (e.g. NEPAD 2016; Persley and Anthony 2017; CGIAR System Council 2018). By “putting clients, market requirements and value chain needs at the centre of the design and development process for new varieties” (Kimani 2017, p. 21), market-based approaches are meant to increase varietal adoption rates and enhance development impacts by making crop breeding more demand-led (Persley and Anthony 2017). By further including social variables such as gender to better understand and meet the demands of the ‘client’, market-based approaches are also being framed as a way to render crop breeding more gender-responsive, meaning that “the perceptions, interests, needs and priorities of women and men (which differ because of their different roles and

✉ Ida Arff Tarjem
ida.arff.tarjem@nmbu.no

Ola Tveitereid Westengen
ola.westengen@nmbu.no

Poul Wisborg
poul.wisborg@nmbu.no

Katharina Glaab
katharina.glaab@nmbu.no

¹ Department of International Environment and Development Studies, Faculty of Landscape and Society, Norwegian University of Life Sciences, Universitetstunet 1, 1430 Ås, Norway

responsibilities in farming) will be considered in planning and decision-making” (Ashby and Polar 2021a, p. 2).¹ This is evident from initiatives and high-level institutional commitments in the CGIAR Consortium of International Agricultural Research Centers (hereafter the CGIAR), including the Excellence in Breeding Platform (EiB) and the Gender and Breeding Initiative (GBI) and the conceptual and methodological frameworks and tools they have developed (Orr et al. 2018, 2021; Ragot et al. 2018; Ashby and Polar 2021a, b).

The differences and links between ‘market-based’, ‘demand-led’ and ‘gender-responsive’ crop breeding tend to blur and require investigation. The former two are often used interchangeably by interlocutors and in the literature. For analytical clarity, however, we conceive of market-based approaches as a way to contribute to demand-led and gender-responsive crop breeding. While the latter two have become increasingly interrelated (see e.g. Polar et al. 2022), we consider them to be conceptually and methodologically distinct. For instance, demand-led breeding is not gender-responsive if gender is not taken into account (although one may question whether this is, then, truly demand-led). Furthermore, demand-led and gender-responsive breeding may or may not rely on market-based approaches and can instead be supported by, for instance, more traditional participatory approaches to plant breeding (e.g. Sperling et al. 2001; Caccarelli and Grando 2007; Joshi et al. 2007; De Haan et al. 2019). While the adaptation of private sector and market-based approaches to development-oriented crop breeding is not novel (e.g. Sumberg and Reece 2004; Sumberg et al. 2013a), the extent to which and the ways in which these approaches are now being institutionalised is unprecedented and thus warrant critical attention.

The conflation of gender and market-based approaches in agricultural research and development is far from new and has been subject to criticism in the broader development literature (e.g. Cornwall et al. 2008; Roberts and Soederberg 2012; Collins 2016, 2018; Esquivel 2017; Gengenbach et al. 2018; Lyon et al. 2019; Prügl et al. 2021). However, few studies have examined the actors, discourses, practices and tools of the new market-based approaches to demand-led and gender-responsive crop breeding. Furthermore, despite the now frequent use of the term ‘market’ in crop breeding discourse, little critical attention has been paid to its meaning and how it is co-constructed with ‘demand’ and ‘gender’, particularly in relation to societal development objectives, including gender equality and women’s empowerment.

Based on an institutional ethnography of high-profile development-oriented breeding initiatives, we unpack these terms and their co-construction, with the aim of contributing to the understanding of how gender-responsive demand is constructed in development-oriented crop breeding. In the analysis, we use perspectives from political agronomy to foreground the performative role of human actors, institutional settings and broader narratives and discourses, while insights from feminist science and technology studies (STS) further draw materiality and nonhuman actors into the analytical frame. We contend that, by putting these two scholarly streams into conversation, we gain a richer empirical and theoretical understanding of the mutual shaping of markets, demand and gender.

We find that the market is understood as an effective socioeconomic institution for soliciting demand, but also becomes a normative agenda. Across the continuum from socioeconomic institution to its normative meaning, the market is pivotal in the creation of an economic and ideological framework through which people, crops and crop products, traits and characteristics are afforded value. We identify a form of ‘gene fetishism’ (Haraway 1997), or what we refer to as ‘trait fetishism’, whereby the crop trait itself becomes the source of value, with some traits rendered less visible. Thus, it matters which markets are made, by whom and how, which in turn shape whose demand comes to matter. Indeed, markets are boundary-making and world-making.

The article contributes to political agronomy and feminist STS by empirically investigating the co-construction of markets, demand and gender in crop breeding for development, which remains an underexplored topic in both fields. Additionally, we expand on the ‘contested agronomy argument’ of political agronomy, asserting that the ‘gender agenda’ must be recognised alongside other agendas that have shaped development-oriented agronomy over the last decades (Sumberg et al. 2012a). By further putting political agronomy and feminist STS into conversation, the article is novel in its contribution to advancing a feminist political agronomy.

In the following sections, we start by presenting the analytical framework and the methods and materials upon which the article is based. Subsequently, we outline the rise of market-based approaches to demand-led and gender-responsive crop breeding, drawing particular attention to the work of, and partnership between, the EiB and GBI. Subsequently, we unpack and discuss the market and its mutually shaped relationship with demand and gender from the perspective of political agronomy and feminist STS, before concluding.

¹ The ‘client’ is defined as “a customer, buyer, purchaser or receiver of a new crop variety, its crop produce or processed material from a seller, vendor or supplier in the value chain for a monetary or other consideration” (Tongoona et al. 2017, p. 65).

Towards a feminist and more-than-human political agronomy

Political agronomy foregrounds the knowledge politics (i.e. the normative assumptions, political-institutional agendas and epistemological and technological logics) through which agricultural knowledge and technological innovations become constructed, shaped and contested. Scholars in political agronomy put forth the contested agronomy argument (Sumberg et al. 2012a), which holds that the neoliberal project and the environmental and the participation agendas have “undermined the long-standing unity of purpose between government policy and agronomic objectives which dominated the politics of agricultural science for much of the last century” (Sumberg et al. 2013b). The neoliberal project refers to the growing role that the private sector plays as a driving force for agrarian change (e.g. Friedmann and McMichael 1989; Friedmann 1993; Kherallah et al. 2000; Akram-Lodhi 2013; Moseley et al. 2015), while the environmental agenda has drawn attention to the health and environmental impacts of (industrial) agriculture (e.g. Carson 1962; Loevinsohn 1987; Pimentel and Pimentel 1990; Pingali and Rosengrant 1994). Finally, the participation agenda, in attending to the rights and emancipation of farmers as a goal in and of itself, as well as a way to achieve more efficient development management (Sumberg et al. 2012a), has called for de-centralised, participatory and bottom-up approaches to agricultural research and development (e.g. Richards 1985; Chambers et al. 1989; Scoones and Thompson 1994, 2009).

Thus, political agronomy helps attend to the human actors, institutional settings and broader narratives and discourses involved in contestations over the place and shape of the market, demand and gender in crop breeding. However, to gain a fuller understanding of this dynamic relationship, we argue in favour of adding a fourth element to the contested agronomy argument: the gender agenda. Indeed, the topic and dimensions of gender have challenged and to some extent shaped agricultural research and development since at least the 1970s (e.g. Sachs 2019; van der Burg 2019; Farhall and Rickards 2021; Prügl and Joshi 2021; Pyburn and Eerdewijk 2021; Sachs et al. 2021). This includes the numerous ways in which gender has shown to be integral to the neoliberal project and the environmental and participation agendas (e.g. Nelson et al. 2002; Razavi 2002; Farnworth and Jiggins 2003; Johnson et al. 2004; Prügl et al. 2012; Galié 2013; Jost et al. 2016; Collins 2018; Ampaire et al. 2020).

Still, political agronomy has yet to significantly engage with gender studies and feminist theories. In the edited volume by Sumberg and Thompson (2012) that helped define

the field of political agronomy, Sumberg et al. (2012a) note how the participation agenda has highlighted women’s role in agriculture and the need to empower women farmers, but the authors did not identify a separate gender agenda. When gender is mentioned elsewhere in the book, it is most commonly in passing (e.g. Erenstein 2012, p. 58; Ramisch 2012, p. 152; Sumberg et al. 2012b, p. 188; Woodhouse 2012, p. 110). In a more recent contribution to political agronomy, Westengen et al. (2018) identify both the climate smart agenda and the gender agenda as “strategic framings in response to international policy trends” in the context of conservation agriculture in Zambia (also see Whitfield 2016), but do not draw on feminist scholarship or develop a broader argument on gender. Taylor et al. (2021), in turn, argue that divisions of class, ethnicity and gender are often “silenced in agronomic research”, but do not extend the gender analysis further in their exploration of the knowledge politics of hybrid NERICA rice in India and Uganda, despite recognising that NERICA is also being promoted as a means to increase gender equality even if women are among the groups likely to experience increased drudgery related to NERICA.

Among the most thorough accounts of gender in the political agronomy literature, a book chapter by Rao and Huggins (2017) addresses gender and women’s empowerment in the context of biofortified orange-fleshed sweet potato in Tanzania. The authors argue that the assumption that “women who adopt [orange-fleshed sweet potato] will feed it to their children (and eat it themselves), resulting in nutritional benefits (...) seldom plays out so neatly” (p. 107). Rather, Rao and Huggins (2017) demonstrate how the commercialisation of orange-fleshed sweet potatoes, which is traditionally considered a ‘women’s crop’, is likely to negatively impact women, while favouring men in terms of income generation. Rao and Huggins (2017) assert that “[p]rojects rarely address the underlying gender relations and inequalities (including labour, time and resource allocation) that prevent both men and women from benefiting from these kinds of externally supported initiatives for farmers” (p. 107).

Thus, while gender, if at all addressed, in most cases appears to be lurking in the background of analysis, the literature demonstrates that gender does matter to political agronomy. Indeed, we argue that intersectional gender norms, roles and relations constitute critical components in our understanding of agricultural knowledge production and technological innovation and adoption. Thus, political agronomy has much to gain from engaging with gender studies and feminist scholarships in similar ways to that which has been achieved in feminist political ecology and feminist political economy (e.g. Mutari 2001; Mollett and Faria 2013; Rai and Waylen 2014; Harcourt and Nelson 2015; Rocheleau and Nirmal 2015). We

explore how feminist streams within STS and related fields can help broaden out the perspective on development-oriented crop breeding.

As Susan Leigh Star (1990, p. 43) and Donna Haraway (1997, p. 113) ask: *Cui bono?* Similarly, we may ask: whom do market-based approaches to demand-led and gender-responsive crop breeding serve? Or, said differently, whose demand comes to matter? Both Star and Haraway, along with other feminist scholars writing under such umbrellas as STS, posthumanism and new materialism, further argue that answering such questions require us to attend to both human and nonhuman actors and their relations (e.g. Barad 2003, 2007; Haraway 2008; Frost 2011; Braidotti 2021). In their agential realist framework, Karen Barad coined ‘intra-action’ (in contrast to interaction) to capture how the ability to act emerges from within, and not outside of, relationships among things (Barad 2007). Thus, agential realism extends agency beyond the ‘autonomous’, ‘intentionally driven’ and ‘solid’ human being to an understanding of agency as enacted through intra-action among and between human and nonhuman entities.

Thus, we can conceive of the market as an ongoing, relational performance consisting of intra-acting discourses, practices and human and nonhuman actors (also see Callon et al. 2002; Callon et al. 2007; Kjellberg and Helgesson 2007; MacKenzie et al. 2007; Doganova and Eyquem-Renault 2009; Doganova and Karn oe, 2015; Doganova and Muniesa 2015). This enables an understanding of how the market, demand and gender take on different shapes, meanings and outcomes in co-constructed ways. We can further conceptualise research and market discourses, practices, concepts and tools as Baradian ‘apparatuses’ that intra-act with human and nonhuman actors (such as scientists and crops) to produce the matter and meaning of markets, demand and gender. Concurrently, apparatuses also enact exclusionary boundaries (Barad 2003).

The question of who and what is rendered visible and invisible when markets become constructed is particularly critical considering that concepts and frameworks that simplify market processes and make them mentally tractable are essential to how markets function (MacKenzie 2009). Furthermore, as noted by Timothy Mitchell (2007): “[m]arkets would not work if people were not allowed to exclude things, to leave certain costs or claims out of the calculation, and to deny responsibility for certain consequences. (...) From this perspective, economics should be analyzed not in terms of the reality it represents (or fails to represent), but in terms of the arrangements and exclusions it helps to produce” (p. 244). In other words, market design and construction are ultimately about the politics of inclusion and exclusion.

Methods and materials

Methodologically, we use institutional ethnography to study the discourses, practices, tools and lived experiences and tensions of scientists and other experts involved in formulating and implementing market-based approaches to demand-led and gender-responsive breeding programmes. The article draws on qualitative data collected mainly during field research in Kenya and Tanzania in 2019–2020. A total of 48 semi-structured and open-ended interviews were conducted either physically or virtually with crop breeders, agricultural economists and gender specialists from national agricultural research systems and the CGIAR (several of which are or were involved in the EiB and the GBI), as well as with representatives from donor agencies and governmental and non-governmental organisations. Additionally, observations were carried out during a workshop on trait prioritisation and evaluation in rice organised by the International Rice Research Institute, the Tanzania Agricultural Research Institute and the private company AbacusBio; the EiB Virtual Meeting of 2020 and 2021; and a project co-organised by the GBI and the EiB, in which two gender-responsive breeding tools building on market-based approaches were piloted in several African-based breeding programmes of the CGIAR. Finally, document analysis of resources produced by the relevant actors was carried out, which included organisational documents of the CGIAR, policies and frameworks of donor agencies and other development organisations, annual reports and other digital resources produced by the EiB, as well as workshop reports, working papers, briefs and additional resources produced by the GBI.

The rise of market-based approaches to demand-led and gender-responsive crop breeding

In 1986, Janice Jiggins published findings from the first assessment of gender-related impacts of the CGIAR, concluding that crop breeding programmes largely failed to include the needs, preferences and selection criteria of women (Jiggins 1986). She further argued that research programming should shift “the balance of decision-making to the collaborative model of commercial and industrial technology development, in which consumers and producers as well as the academic community, agricultural scientists, and the food industry have a determining voice” (Jiggins 1986, p. 85). Jiggins distinguished between agricultural research and technology development, contending that “[t]he latter has no function outside a definable market

or market potential and the process of meeting the needs of that market cannot be effective and profitable without the involvement of members of that market in the determination of research criteria, design, testing and evaluation, or without early consideration of promotion, sales and servicing" (Jiggins 1986, p. 21).

The report by Janice Jiggins would contribute to the establishment of the CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation in 1997, which was meant to help develop "methodologies and organizational innovations for gender-sensitive participatory research" in plant breeding and natural resource management (CGIAR Science Council 2007, p. 1; also see Farnworth and Jiggins 2003). Testament of the interrelations between the participation and gender agendas, the project helped strengthen the need to engage both men and women farmers in participatory approaches to plant breeding, which has commonly involved evaluation of soon-to-be-released varieties either on-farm or on-station (i.e. participatory varietal selection). However, questions have been raised about the extent to which participatory approaches adequately reflect the wider conditions under which different social groups perform agricultural labour, their preferences beyond the (often production-related) traits already selected by the breeders, and their real-life decision-making and adoption behaviours, as well as the extent to which social and gender researchers are able to influence varietal design (e.g. Cernea and Kassam 2005; Ashby et al. 2013; Almekinders et al. 2019; Weltzien et al. 2019; Cairns et al. 2021; Voss et al. 2021).

However, the link that Jiggins made between gender, technology (varietal) development and definable markets, and the more collaborative model of decision-making, would not become widely tested in practice until almost four decades later. Dissatisfied with the low levels of adoption and development impacts of improved crop varieties, especially in African countries (e.g. Fisher and Carr 2015; Acevedo et al. 2020; Thiele et al. 2021), the Bill and Melinda Gates Foundation (hereafter the Gates Foundation) commissioned in 2016 an assessment of several CGIAR breeding programmes. The assessment would be carried out using the Breeding Program Assessment Tool (CGIAR System Management Office 2018), which employs criteria used to evaluate the effectiveness and efficiency of commercial crop breeding programmes. The development and use of the tool were led by the University of Queensland, Australia, which is a key partner of the Demand-Led Breeding (DLB) group.

The DLB group consists of a partnership between several African academic and research organisations (some of which are also part of the CGIAR), supported by the Alliance for Food Security in Africa, which comprises of the Australian Centre for International Agricultural Research, the Crawford

Fund and the Syngenta Foundation for Sustainable Agriculture (hereafter the Syngenta Foundation) (Persley and Anthony 2017). In 2017, the group published the handbook *The business of plant breeding: Market-based approaches to plant variety design in Africa* which described demand-led breeding as combining "the best practices in market-based new variety design with innovative plant breeding methods and integrates both of these with the best practices in business as a new way of approaching the business of plant breeding to deliver benefits" (Persley and Anthony 2017, p. xi). Closely associated with both the neoliberal project and participation agenda, market-based approaches are said to go beyond the limited geographical and user scope of participatory approaches to plant breeding, with proposed benefits including "higher adoption rates, the tapping of larger markets and hence the use of economies of scale. It can lead to better returns to investment and is potentially attractive to private investment" (Kimani 2017, p. 21).²

The assessment of CGIAR breeding programmes using the Breeding Program Assessment Tool identified a key missing component to be the "systematic use of product profiles, based on continually updated market intelligence and stakeholder consultations, to ensure that new varieties are designed to meet the requirements and preferences of women and men farmers, consumers, traders, processors and others along the value chain" (CGIAR System Council 2018, p. 7). Product profiles, which are standard in most commercial crop breeding programmes, can be defined as "the full set of targeted attributes, or the ideotype, that a new plant variety or animal breed is expected to meet to successfully be released onto a market segment" (Ashby and Polar 2021a, p. 2).³ The market segment constitutes a "geographic area or a group of people having a relatively homogeneous demand for a commodity" (Ragot et al. 2018).⁴ The assessment of CGIAR breeding programmes would further come to inform the establishment of the Funder-led Crops to End Hunger initiative which is meant to help facilitate "a comprehensive modernization agenda for crop breeding in the CGIAR",

² While the environmental agenda is less evident in the context of this research, it is present in arguments that demand-led and gender-responsive crop varieties can help increase adoption rates of climate resilient varieties.

³ The plant ideotype was first defined by Donald (1968) as, in the broadest sense, "a biological model which is expected to perform or behave in a predictable manner within a defined environment. More specifically, a crop ideotype is a plant model which is expected to yield a greater quantity or quality of grain, oil or other useful product when developed as a cultivar" (p. 389).

⁴ The market segment is similar to what was known in the 1970s and 1980s as 'recommendation domains', defined as "[a] group of roughly homogeneous farmers with similar circumstances for whom we can make more or less the same recommendation" (Byerlee et al. 1988 [1980], p. 71).

which includes the institutionalisation of market-informed product profiles (CGIAR System Council 2018, p. 1).

Established in 2017, the CGIAR Excellence in Breeding Platform (EiB)—which has drawn on the work of the DLB group, as evidenced during an interview with a representative from the EiB, who had the DLB handbook on display in their office—was tasked with coordinating and overseeing the Crops to End Hunger initiative (EiB n.d.). Module 1 of the EiB on product design and management is responsible for institutionalising the market-based product profile development framework, which in practice entails assisting CGIAR breeding teams and national partners in segmenting the market in which the breeding programme operates and thereafter aligning breeding pipelines and designing product profiles (also see Mashonganyika 2018). Thus far, in close cooperation with breeding programmes, the EiB has identified 320 market segments across 26 crops, boasting that these reflect “a unique combination of grower and consumer needs and all are gender-inclusive” (EiB 2021, p. 3). Indeed, since 2017, the EiB has engaged in conversations with the CGIAR Gender and Breeding Initiative (GBI) to explore the possibility of incorporating their gender-responsive breeding tools into EiB’s product profile development framework (EiB 2018, 2019).

In 2016, a group of crop breeders, geneticists, economists and gender specialists from and beyond the CGIAR met in Nairobi, Kenya, to discuss how to “help catalyze a deliberate shift towards gender-responsive breeding in the CGIAR” (CGIAR Gender and Breeding Initiative 2017, p. 1). The group convened the following year, this time officially known as the GBI, hosted and coordinated by the CGIAR Research Program on Roots, Tubers and Bananas and the International Potato Center. During its foundational workshops, the GBI also invited a private sector company and engaged a consultant with expertise in commercial breeding to inspire new ways and frames of thinking on how to systematically bring gender into the crop breeding process, including at the very initial stages when priorities are set and varieties are designed. We thus see instances of the conflation of the neoliberal project and gender agenda. Together with the consultant, the GBI developed a working paper titled *From market demand to breeding decisions: A framework*, which presented a framework based on market segmentation and product profiles meant to help capture and respond to gendered needs and market demands through breeding (Ragot et al. 2018). Notably, the Syngenta Foundation, which as mentioned is one of the key partners of the DLB group, is among the clients of the consultant (Nouvelle France Genetics n.d.), thus indicating cross-cutting relations and knowledge sharing.

In a companion paper, Orr et al. (2018) further argued that gender and social targeting for resource-poor stakeholders requires a marketing approach. The paper advocates

the use of an adapted version of the consumer marketing approach Segmenting-Targeting-Positioning, around which the GBI would come to design a set of gender-responsive crop breeding tools known as the Gender+ Tools (G+ Tools) (Ashby and Polar 2021a, b; Orr et al. 2021; also see Forsythe et al. 2021). The G+ Tools consist of the G+ Customer Profile Tool and the G+ Product Profile Query Tool, both of which are to be used by a social scientist with gender expertise together with a breeder familiar with market-based breeding approaches.⁵ By collating geographical, gender and other social variables, the G+ Customer Profile Tool helps segment, target and profile the customers of a breeding programme (Ashby and Polar 2021a). The G+ Product Profile Query Tool, in turn, “conducts an analysis of gender gaps in agriculture to help a breeding program detect whether a given trait has implications for gender equity in farming and in the rest of a commodity’s value chain” (Ashby and Polar 2021b, p. 2), and generates “positive and negative ordinal values for a gender impact score to help breeders score and rank the traits to prioritize” (Ashby and Polar 2021b, p. 2). In 2020, the G+ Tools were piloted in several African-based breeding programmes of the CGIAR, including cassava, sweet potato and bean breeding programmes, in a project co-managed and co-sponsored by the GBI and EiB (also see Polar et al. 2022). Besides refining and adjusting the tools, the project explored ways of adapting the tools to the EiB product profile development framework.

Unpacking the market and its co-construction with demand and gender

Next, we consider how the discourses, practices and human and nonhuman actors involved in the new market-based approaches to demand-led and gender-responsive crop breeding shape the matter and meanings of the market, demand and gender in co-constructed ways. We find that the market is understood as an effective socioeconomic institution for soliciting demand, but also becomes a normative agenda.

⁵ The GBI uses the concept ‘customer segments’, which expands somewhat on the definition of a market segment: “[a] group of users who have both a common set of constraints and a common, unique and relatively homogenous need (demand) for a breeding program product” (Orr et al. 2021, p. 19). Similar to the definition of the ‘client’, the ‘customer’ is defined as “the growers who use the breeding product (crop varieties or animal breeds), and the other value chain actors, like traders, processors, or consumers who use one or more of the end-products” (Orr et al. 2021, p. 5).

The gendered and more-than-human marketplace

In the DLB handbook, the market is defined very concretely as “a forum that allows buyers and sellers of a specific good or service to interact in order to facilitate an exchange” (Tongoona et al. 2017, p. 77). In other words, the market is understood in the more conventional sense of a socioeconomic institution—in this case a marketplace—for exchanging goods. Consistent with Moseley’s (2021) argument that the market has become equated to the value chain in development literature, the market in market-based approaches is further defined according to the agricultural value chain, which describes “a set of value-adding activities performed by all actors from production through to the consumption of a specified product. (...) Value chain analysis helps in understanding the buying and selling decisions of each stakeholder in the supply chain from farmer (or producer) to consumer” (Kimani 2017, p. 17). Demand, then, can be understood as the “needs and/or preferences expressed by different value chain actors” (Ragot et al. 2018, p. 9).

The piloting of the G+ Tools revealed the character of this value chain understanding of markets and demand, and further demonstrated how gender enters the equation. Using the G+ Customer Profile Tool, the piloting teams mapped different crop products and sex-disaggregated actors along the respective value chain. Combined with an understanding of gender differences in rights, roles and status, demand (i.e. preferences and needs) was seen as reflecting the unique responsibilities and labour of men and women along the value chain, which further differed according to whether they were involved in formal or informal markets or urban or rural markets. In several cases, the available data revealed that men more so than women were engaged in large-scale marketing and transportation, which was translated into men expressing higher demands for agronomic traits for income generation (e.g. various forms of yield), among others. In turn, women’s demands were often seen as reflecting their roles in labour-intensive production tasks and post-harvest activities, such as weeding, harvesting, processing and cooking, as well as in household food security. In some cases, the role of industry in shaping demand was also highlighted, leading to a differentiation between the food market and the industrial market.

Additionally, using the G+ Customer Profile Tool, the customer segments were described according to such factors as the size of the market, market value, average selling price, predicted growth (visioning and foresight are key in market-based approaches) and expected development impacts (e.g. poverty alleviation, food security, nutrition, gender equality and climate mitigation). Together with output generated using the G+ Product Profile Query Tool, the G+ Tools thus help segment and target market or customer segments, upon which product profiles can be designed, taking gender into

account. For instance, for cassava in Nigeria, the piloting team selected a segment consisting of small and medium-scale farmers and processors (many of whom are women) that produce fermented cassava products (e.g. *gari* and *fufu*) both for home consumption and for marketing in rural and urban areas. For sweet potato in Uganda, the piloting team targeted a segment consisting of men and women small-holder farmers producing orange-fleshed and white-fleshed sweet potato either for food use (boiled or as flour) or for processing (also see Polar et al. 2022). Thus, demand also reflected the end use of the product and its processing.

Consequently, the construction of markets and gender appears mutually reinforcing: the market provides an analytical lens through which to delineate gendered customers and demand. In turn, including gender as a variable allows further micro-segmentation of the market and the potential identification of underserved market segments, thus providing an improved understanding of who the clients are and their demands. As a gender specialist put it:

Especially in Africa, women are big decision-makers on what is planted, what is eaten, what is utilised at the household. (...) So that places women at a very special place [in] unlocking this whole demand.

According to literature on the shaping of markets (e.g. Callon et al. 2007; Kjellberg and Helgesson 2007; MacKenzie et al. 2007; Doganova and Eyquem-Renault 2009; Doganova and Karnøe 2015; Doganova 2020), devices such as the G+ Tools do not only describe but indeed construct the market. Thus, through intra-action between the breeding teams and the G+ Tools (i.e. Baradian apparatuses), differential markets are brought into being, consisting of different arrangements of intra-acting value chain actors, crops, crop traits and products, geographical areas and other variables, which in turn co-produce demand and gender. This is a power-driven and political act, as it implicates moving humans and nonhumans from outside to inside the market. That which falls outside the market thus becomes “constituted in terms of its relation to the market—that is, in terms of its deficiencies, as the nonmarket, as something defective or dead” (Mitchell 2007, p. 248). What happens, then, to those human and nonhuman beings and ways of being that are part of the nonmarket or whose demand is not considered homogeneous enough to be considered demand in the first place? Or does the inclusion of gender as a variable in market segmentation and targeting result in the construction of fairer and more just markets and demands?

As expressed by several interlocutors, including gender as a variable or component represents a powerful rhetorical resource and politically strategic way of rendering gender tangible in a more technical and biophysical way, which in turn can help support gender objectives in and through crop breeding. In a sense then, similar to

observations made by Comaroff and Comaroff (2009) on ethnicity, gender is “rendered negotiable by means of the abstract instruments of the market” (p. 24). Encouragingly, Polar et al. (2022) note that “[u]sing the G+ tools stimulated (...) a demand for deeper gender analysis” (p. 504). However, when demand and gender are reduced to a variable or component, such as sex-disaggregated trait and varietal preferences, there is a danger of masking the structural, institutional and relational dimensions of demand and gender, as addressed further below. Moreover, trait and varietal preferences may not fully predict adoption and buying behaviour (e.g. Cairns et al. 2021) nor do they necessarily represent meaningful choices and may in several cases reflect “a self-subordinating adaptation to a restricted choice, to accommodate (...) inferior access to labor, capital, farm equipment, seed, fertilizers, pest control products and market access” (Polar et al. 2021).

Furthermore, research methods for eliciting demand are themselves performative and (re)produce only certain aspects of demand (e.g. Law 2009; Law and Ruppert 2013; Almekinders et al. 2019). For instance, Almekinders et al. (2019) note how “willingness-to-pay studies enable farmers to display the behaviour of a market actor that takes rational decisions. (...) They may, for example, not consider farmers’ behaviour as employers of landless labourers, as parents wanting to teach their children, or as good community members that feel the obligation to share with and/or use seeds”. Many of the behaviours that Almekinders et al. (2019) describe are likely shaped by intersectional gender norms and relations. Thus, when defined according to expressed preferences and needs generated using methods that provide only partial perspectives, we gain only a limited understanding of what constitutes demand, including its gendered nature. Consequently, this may render other needs less visible, including the need for relational, collective and structural change.

Additionally, gender is just one of many factors used to define the market and demand. Our own and others’ observations indicate that the definition of market segments in the CGIAR has thus far been geared towards agroecological zones and agronomic factors. For instance, Cobb et al. (2019) note how “social science teams at institutions such as CGIAR centers have developed protocols for assigning relative values to traits in interactions with particular subsets of farmers, but this has rarely carried through to the design of formal product profiles”. These findings indicate that, despite multidisciplinary breeding teams being a key principle in market-based approaches, much of the decision-making power remains in the hands of the crop breeders, which in turn render the work of gender specialists, and the gender specialists themselves, less visible. A participant at the EiB Virtual Meeting in 2020 observed a discussion

taking place in the digital chat, which told of the EiB’s lack of engagement with social scientists:

I think the point has come up in the chat a couple of times regarding the role of social scientists [and] getting help from social science teams in both characterising market segment and designing product profiles, and we know that EiB has [inaudible] no capacity in that area.

However, due to the increasing role they play in international development, donors are likely to have a greater impact on the choice of market segments and product profile design than crop breeders (e.g. Pingali et al. 2012, 2016; Richey and Ponte 2014; Haydon et al. 2021). As a crop breeder put it: “behind the scenes, everything is driven by the donors. So, they tell you: ‘we have money to do drought’. You cannot tell them: ‘no, no, no, we cannot do drought because nutrition is the biggest problem’. They won’t listen to you. You lose the money”. Indeed, almost every respondent we talked to argued or agreed that private sector donors, notably the Gates Foundation, were the major drivers of both the gender agenda and market-based turn in the CGIAR. In other words, through the lens of knowledge politics, we see how institutional and disciplinary power dynamics situate groups of human actors, many of whom have diverging interests and values, differently in the broader system of crop breeding organisations. This renders particular actors, notably crop breeders and donors, more ‘powerful’ and strategically positioned in market design and construction. Thus, the question of *whose* demand is intimately connected to the question of *who* demands.

Donors may or may not favour market segments that include defined gender objectives, depending on whether these are perceived to have the highest achievable impact and how impact is measured and valued. Other factors such as the level of poverty, the size of the market, the market value, the number of farmers and predicted growth may come to outweigh gender objectives (although these are not mutually exclusive). Notably, a gender specialist shared a story of when she had been told by a donor representative that what was most critical was the market and the economics at play, and that “we can get it without gender, but with gender it sounds nice”. This may suggest that gender commitments are, at times, mostly tokenistic and an act of lip service. As an interlocutor observed: “[T]he Gates programme officers that I know, mostly haven’t taken gender very seriously”.

These comments raise important questions about what will, in fact, be considered ‘valuable’ within a market-based framework to crop breeding. As argued by Doganova (2020), the broader question of “what is the value of (...)?” is “increasingly addressed in the language of quantification and economic calculation” (p. 256). Tellingly, there are increasing efforts in the CGIAR to generate market

intelligence that allows economic values to be assigned to different crop traits. Among others, several CGIAR breeding programmes, some with financial support from the EiB, have carried out projects in cooperation with the private company AbacusBio (e.g. Ibabao 2019; Teeken et al. 2021; Balogun et al. 2022). AbacusBio uses a software called 1000Minds, which is based on conjoint analysis that 'forces' surveyed value chain actors to make trait-by-trait trade-offs, where each trait has a quantitative value (Balogun et al. 2022). The output of the survey "provides insights into segmentation of the population (...) [and] also informs derivation of economic values that can be employed by breeders in making selection decisions" (Balogun et al. 2022). Thus, we can conceptualise the 1000Minds software as also representing a Baradian apparatus.

However, attaching monetary values to the social functions of crops has proven difficult, as expressed by a crop breeder:

We hear this in cassava for example, in-ground storability, how long something can stay in the ground after it has matured. You can't put a dollar value on that because the reason for that is its flexibility and harvest. It is a food security function. (...) So, try to define a market around that or put a value on that... I mean, good luck! I don't even know how you can. So, we are struggling with that a little bit and re-defining what a market means is. (...) Because otherwise we are not going to get out of that same rut of yield. Because yield means more profit, right, you can't argue with that. There is a dollar value very heavily attached to that.

Thus, some interlocutors expressed concerns about what would happen to crops and crop characteristics, trait and products less strongly tied to markets and economic valuation. As a gender specialist expressed it: "My worry though is, like, the big funders of breeding research are very, very interested in the market-based breeding. And so, over time, you'll find that the breeding for these nonmarket-oriented varieties become a bit of a challenge". They further pointed out that many women smallholders are customarily in charge of nonmarket-oriented varieties, which often constitute subsistence or food security crops. In contrast, crops such as maize were described by an agricultural economist as "one of the business-wise most interesting crops. It's bulky, it is cultivated everywhere, and they can buy it every year [in the case of hybrid varieties]. So, seed companies have a real interest in growing maize. Unlike if you grow sorghum; as a company, that is not really a money-maker". What is articulated here is a recognition of the fundamentally important role that the crops and their characteristics play in shaping agricultural development.

The ways in which the traits of, for example, cassava and maize have primed for very different agricultural, and therefore societal, trajectories have long been recognised by agrarian scholars and environmental historians (e.g. McCann 2007; Scott 2009, 2017). Contemporary studies of the same crops have shown that also today their characteristics may both promote or inhibit enrolment in market relations (e.g. Fischer 2022; Roman and Westengen 2022). Fischer (2022) uses the concept of intra-action to describe how the properties of maize intra-act "with local ecologies and farm practices as well as with markets and policies". Moreover, crops are also implicated in the performance of gender (e.g. Tapia and De la Torre 1998; Fritz 1999; Howard 2003; Padmanabhan 2007). For instance, Amadiume (1987) and Korieh (2007, 2010) show how yam and cassava have been a defining feature of male and female identity in Nigeria, respectively. Thus, we have to, as Catriona Sandilands argues when discussing the feminist vegetal turn, "look at the specific, material ways in which particular people have relations with particular plants in particular moments, both as these relations may serve the interests of heteropatriarchal capitalism and as they might offer sites of resistance" (Cielemęcka and Szczygielska 2019).

However, upon questioning, a crop breeder from the DLB group was quick to argue that market-based approaches would leave no trait behind:

Almost any trait has economic value. If somebody values it, that is a market. [...] If somebody likes it, that is a market. Everything has a market! What may differ is the size of that market. What you may say is that there are niche markets and there are bigger markets. There are winning traits and must-have traits. [...] So this is why I find it completely encompassing.

This is reminiscent of Donna Haraway's 'gene fetishism' (building on Marx's 'commodity fetishism'), where genes themselves are seen as the source of value (Haraway 1997). "This kind of gene fetishism", Haraway (1997) argues, "rests on the denial and disavowal of all the natural-social articulations and agentic relationships among researchers, farmers, factory workers, patients, policy-makers, molecules, model organisms, machines, forests, seeds, financial instruments, computers, and much else that bring 'genes' into material-semiotic being" (p. 143). Similarly, the kind of 'trait fetishism' (which is fundamentally a type of gene fetishism) we have observed in market-based approaches to demand-led and gender-responsive crop breeding may have the effect of concealing the human-nonhuman intra-actions and the knowledge politics involved in bringing traits into being or indeed render some traits (and their underlying relational arrangements and politics) less visible, notably those considered

less economically valuable or for which it is challenging to determine a monetary value.

Gender and the market as a normative agenda

Ideologically, the market was seen by proponents of market-based approaches as a way to transform ‘traditional’, subsistence-based livelihoods of resource-poor, small-scale farmers. Firmly situated within the neoliberal project, a crop breeder involved in the DLB group expressed: “we want to transform farmers livelihood mainly with income generation”; while another argued that “you don’t have to grow something because you eat it. No, it is because it has a market. Once you have the money, you can decide what to eat”. Moreover, the market and market-based approaches were portrayed as equitable, fair and self-sustaining, as exemplified by a statement by a crop breeder of the DLB group:

The more you do business-oriented breeding, the more it helps everybody. (...) It does not disadvantage any group. (...) It doesn’t matter whether you are a man or woman. Anybody can do business.

Indicative of the conflated relationship between the neoliberal project and the gender agenda, this and similar statements further echoed a perception of women as entrepreneurial, business savvy and “pretty competitive. (...) just go downtown [to the marketplace] and you’ll see”, as one interlocutor said. Such a perception also aligns with a normative perspective where individuals are expected “to take care of themselves and operate successfully under competition” (Altan-Olcay 2015; also see Rankin 2010). Highlighting such characteristics can be seen as moving beyond (albeit not fully replacing) traditional and more degrading conceptions of ‘third world women’ as “helpless beggars” (Bajde 2013) and “suffering victims” (Valencia-Fourcans and Hawkins 2016) who lack agency and become passive recipients of development (e.g. Mohanty 1984; Spivak 1988; Peterson 2010; Wilson 2011). As a gender specialist expressed when talking about African women agri-business owners:

[Let’s] not paint a black tone picture [of] a woman with a [hand] hoe, you know, struggling there with a torn kitenge (...). Look, they are providing employment! Look, they have overcome so many barriers for them to be where they are!

Constructing women in this way shares parallels also to neoliberal and normative arguments for efficiency. As touched upon, market-based approaches more broadly are framed as a way to increase the efficiency and effectiveness of crop breeding in terms of, most notably, higher varietal adoption and turnover rates and, as a result, enhanced development impacts and thus returns on donor investments.

More specifically, market-based approaches also tap into the “efficiency argument for gender equality”, which is strongly related to the “business case for gender equality” and “gender as smart economics” (e.g. World Bank 2006, 2012; Chant and Sweetman 2012; Roberts and Soederberg 2012; Berik 2017), thus further demonstrating the conflation of the neoliberal project and the gender agenda.

With a legacy dating back to the Women and Development paradigm of the 1970s (Chant and Sweetman 2012), the efficiency argument holds that reducing gender inequality and investing in women result in more effective corporate performance, higher economic growth and improved development outcomes. Women are often portrayed as more efficient and responsible than their male counterparts (e.g. for child health, nutrition and education) (e.g. Lyon et al. 2019; Prügl and Joshi 2021), but prevented from reaching their full, ‘untapped’ potential due to gender inequalities in, among others, access to productive resources and markets (e.g. FAO 2011). Thus, by integrating women more tightly into the market, market-based approaches are also framed as a way to contribute to gender equality and women’s empowerment.

Doss (2017, 2018), however, draws attention to how the conceptual thinking and empirical basis for women-focused agricultural development have yet to be well developed (also see e.g. O’Laughlin 2007; Anderson et al. 2021). Gengenbach et al. (2018) further note how the assumption that “simply incorporating women farmers into agricultural value chains will boost rural incomes and food security” is problematic as it tends to ignore “varied axes of differentiation among rural women” (Gengenbach et al. 2018). For instance, access to well-functioning markets, market information and bargaining power during market exchanges can be highly structured according to intersectional gender norms and relations (World Bank et al. 2009). Thus, while place and time-specific nuances exist (e.g. Forsythe et al. 2015, 2016; Quisumbing et al. 2015; Orr et al. 2016; Rousseau et al. 2019; Crossland et al. 2021), several studies have shown that the introduction of new crop varieties and shifts in markets and on-farm practices can enhance men’s control over crops and decision-making at the cost of female disenfranchisement and drudgery, particularly when food and subsistence crops become commercialised (e.g. Carney and Watts 1990, 1991; Sorensen 1996; Dolan 2001; Njuki et al. 2011; Fischer and Qaim 2012; Kent 2018; Tavenner et al. 2019; Dzanku et al. 2021). Thus, a gender specialist expressed her concern about the attention afforded to commercialisation in the CGIAR:

[A] lot of the work that we do is about commercialisation. And I find that quite problematic for two reasons: because commercialisation I think is very gendered, and two, because I don’t think necessarily everybody

wants to go for commercialisation. (...) I think when you go into commercialisation then (...) suddenly you change the division of labour and the benefits. And then there is probably the question also for those who are interested in commercialisation [but] can't actually get there.

In other words, the evidence base supporting market-based approaches to gender equality and women's empowerment remains poor (Gengenbach et al. 2018). Furthermore, the efficiency argument for gender equality has been strongly criticised by feminist scholars for defining agency and empowerment as an exercise of individual choice and preference and in terms of efficiency, productivity, market participation and acquisition of assets. They argue that such a narrow definition may undermine structural, relational and collective dimensions of agency and gender and strengthen rather than challenge patriarchal and capitalist institutions of power (e.g. Lewis 2001; Wilson 2011, 2015; Chant and Sweetman 2012; Roberts and Soederberg 2012; Cornwall and Rivas 2015; Collins 2016; Esquivel 2017; Haydon et al. 2021).

However, as noted by Ferguson (2015), there is currently little funding outside of the "business case for gender equality" framework, which means that gender experts often "end up speaking in this language and preparing reports, speeches and presentations that reinforce the embedding of a narrow and problematic vision of gender equality". Indeed, the efficiency argument has become highly advocated by private sector donors, including the Gates Foundation (Gates Foundation 2008, 2012, n.d.; Gates 2014, 2019; Fejerskov 2017, 2018; Farhall and Rickards 2021). For instance, in their orientation document on "Creating gender-responsive agricultural development programs", women are framed as instrumental to the success of the foundation, including for the adoption of agricultural technologies (e.g. crop varieties) and for increasing agricultural production (Gates Foundation 2012). Furthermore, published in 2018, the first foundation-wide gender strategy focuses on women's economic empowerment (Gates Foundation n.d).

Thus, when the market is promoted as a normative agenda entailing a set of neoliberal values, such as individualism, effectiveness and competition, according to which demand, gender equality and empowerment become defined, it may contribute to changing the "perceptions of individual worth or value, away from an inherent humanness or collection of basic rights, and towards consideration of what they [women] can contribute economically" (Haydon et al. 2021). Thus, while the market as a normative agenda may bring the individualised demand of the 'entrepreneurial woman' to the fore, many questions remain about the potential of market-based approaches to respond to demand for socially just change at the collective and structural level. Furthermore,

what may the implications be when gender equality and women's empowerment come to hinge on the uncertainty of the market and the commercial success of crop commodities and produce?

Conclusion

Market-based approaches have become a prominent mean to contribute to more demand-led and gender-responsive crop breeding. This is evident from initiatives and high-level organisational commitments and innovations in the CGIAR, including the conceptual and methodological frameworks and tools developed by the Excellence in Breeding (EiB) Platform and the Gender and Breeding Initiative (GBI). However, despite the now frequent use of the term market in crop breeding discourses, little critical attention has been paid to the meaning of this concept and its co-construction with demand and gender, including in relation to societal development objectives. Using a combination of perspectives from political agronomy and feminist STS, we sought to unpack these concepts and their mutual shaping, with the aim of contributing to the understanding of how gender-responsive demand is constructed in development-oriented crop breeding. By putting these two scholarly streams into conversation, we gain a richer empirical and theoretical understanding of the co-construction of markets, demand and gender.

Conceiving of the market as an ongoing, relational performance consisting of intra-acting discourses, practices and human and nonhuman actors enables an understanding of how the market, demand and gender take on different shapes, meanings and outcomes in co-constructed ways, including in ways where the market discourse often comes to dominate. Political agronomy helps foreground the human actors, institutional settings and broader narratives and discourses. In particular, through the lens of knowledge politics, we saw how disciplinary and institutional power dynamics situate crop breeders and donors in especially powerful and strategic positions in market design and construction. Additionally, the contested agronomy argument helped situate and contextualise market-based approaches, especially as they relate to the neoliberal project and the participation and gender agendas. Feminist STS, in turn, in this case using a Baradian framework, allowed us to expand the analytical lens to include materiality and nonhuman actors, including the performative role of the G+ Tools, the 1000Minds software, research methods and crops in the co-construction of markets, demand and gender. Accordingly, feminist STS can complement the cultural and discursive analysis of political agronomy, taking gender into account beyond a mere nod to its importance. Furthermore, feminist perspectives draw into sharp

relief the question of who and what become included and excluded as markets are constructed, determining whose demand comes to matter.

We found that the market in one sense simply means utilising the socioeconomic institution, the marketplace, as a solicitor of demand. In the marketplace, gender tends to be reduced to a variable used to constitute market segments. Including gender as a variable or component represents a politically strategic way of rendering gender tangible in a more technical, biophysical and integrative sense, which in turn can help support gender objectives in and through crop breeding. However, such an integrative component approach may mask the complexity, relationality and institutional and structural dimensions of gender and thus limit our understanding of what constitutes demand. Furthermore, in being one variable among many according to which markets and demands are defined and targeted, and where crop breeders and donors hold much of decision-making power relative to gender specialists, gender appears to take a backseat.

The market-based understanding of gender thus becomes political. As a normative agenda, the market represents a way to transform 'traditional', subsistence-based livelihoods of resource-poor, small-scale farmers in ways considered fair, equitable and sustainable. Gender and demand are framed in neoliberal agential terms, with women constructed as competitive, business savvy, entrepreneurial, responsible and efficient, which in many ways casts women and their agency in more empowering ways. However, there is currently little evidence supporting market-based approaches to gender equality and women's empowerment in agriculture. Indeed, such claims remain problematic as intersectional gender norms and power relations often shape access to markets and information, as well as bargaining and buying power. Furthermore, defining agency and empowerment in terms of individualism, efficiency and market access may undermine, as above, the relational, collective and structural aspects of agency and gender and strengthen rather than challenge patriarchal and capitalist interests and institutions of power.

Across the continuum from socioeconomic institution to normative agenda, the market is pivotal in the creation of an economic and ideological framework through which people, crops and crop products, traits and characteristics are afforded value. This further gives rise to a form of trait fetishism that may conceal the human and nonhuman interactions and the knowledge politics that bring traits into being, while rendering some traits less visible. Indeed, the analysis revealed how humans and nonhumans that do not readily fall within the narrow confines of such a framework may stand in danger of being excluded; as being part of a 'deficient', 'defective' or even 'dead' nonmarket. In other words, the market creates insiders and outsiders, inclusions

and exclusions. Thus, it matters which markets are made, by whom and how, which in turn shape whose demand comes to matter. These are considerations that should be at the forefront as market-based approaches to crop breeding for development are being developed and promoted, including in relation to gender equality and other social development objectives.

The article contributes to political agronomy and feminist STS by empirically investigating the co-construction of markets, demand and gender in crop breeding for development, which remains an underexplored topic in both fields. Additionally, we argue that gender needs to be added as a fourth agenda to the contested agronomy argument, and that doing so allows us to better contextualise and evaluate new market-based approaches. We further assert that political agronomy can benefit from taking feminist STS analysis of materiality and nonhumans seriously, among others because they are sites of human and material resistance to ideologically driven constructions of markets, demand and gender. Given the centrality of gender in farming systems and agricultural knowledge production and technological innovation, the gender agenda and feminist analysis have the potential for broader applications in political agronomy. As such, this article contributes towards advancing a feminist political agronomy.

Acknowledgements We would like to acknowledge and thank Kenyatta University for hosting the lead author during field research in Kenya. We thank the involved CGIAR organisations for facilitating the research and all research participants for generously sharing their time and knowledge.

Funding Open access funding provided by Norwegian University of Life Sciences.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Acevedo, M., K. Pixley, N. Zinyengere, S. Meng, H.A. Tufan, K. Cichy, L. Bizikova, K. Isaacs, K. Ghezzi-Kopel, and J. Porciello. 2020. A scoping review of adoption of climate-resilient crops by small-scale producers in low-and middle-income countries. *Nature Plants* 6: 1231–1241. <https://doi.org/10.1038/s41477-020-00783-z>.

- Akram-Lodhi, H. 2013. *Hungry for change: Farmers, food justice and the agrarian question*. Halifax: Fernwood.
- Almekinders, C.J.M., K. Beumer, M. Hauser, M. Misiko, M. Gatto, A.O. Nkurumwa, and O. Erenstein. 2019. Understanding the relations between farmers' seed demand and research methods: The challenge to do better. *Outlook on Agriculture* 48 (1): 16–21. <https://doi.org/10.1177/0030727019827028>.
- Altan-Olcay, Ö. 2015. The entrepreneurial woman in development programs: Thinking through class differences. *Social Politics: International Studies in Gender, State & Society* 23 (3): 389–414. <https://doi.org/10.1093/sp/jxv013>.
- Amadiume, I. 1987. *Male daughters, female husbands: Gender and sex in an African society*. London: Zed Books.
- Ampaire, E.L., M. Acosta, S. Huyer, R. Kigonya, P. Muchunguzi, R. Muna, and L. Jassogne. 2020. Gender in climate change, agriculture, and natural resource policies: Insights from East Africa. *Climatic Change* 158: 43–60. <https://doi.org/10.1007/s10584-019-02447-0>.
- Anderson, C.L., T.W. Reynolds, P. Biscaye, V. Patwardhan, and C. Schmidt. 2021. Economic benefits of empowering women in agriculture: Assumptions and evidence. *The Journal of Development Studies* 57 (2): 193–208. <https://doi.org/10.1080/00220388.2020.1769071>.
- Ashby, J. A., A. Lubbock, and H. Stuart. 2013. Assessment of the status of gender mainstreaming in CGIAR Research Programs. Nairobi: CGIAR Fund Council. <https://cgspace.cgiar.org/bitstream/handle/10947/30974/4/20Assessment%20of%20the%20Status%20of%20Gender%20Mainstreaming%20in%20CGIAR%20Research%20Programs%203.pdf?sequence=1&isAllowed=y>. Accessed 30 October 2021.
- Ashby, J. A., and V. Polar. 2021a. User guide to the G+ product profile query tool (G+ PP). CGIAR Research Program on Roots, Tubers and Bananas (RTB), User Guide 2021-2. Lima: International Potato Center. <https://cgspace.cgiar.org/bitstream/handle/10568/113167/9789290605959.pdf?sequence=1&isAllowed=y>. Accessed 1 November 2021a.
- Ashby, J. A., and V. Polar. 2021b. User guide to the standard operating procedure for G+ tools (G+SOP). CGIAR Research Program on Roots, Tubers and Bananas (RTB), User Guide 2021-3. Lima: International Potato Center. <https://cgspace.cgiar.org/handle/10568/113166>. Accessed 1 November 2021b.
- Bajde, D. 2013. Marketized philanthropy: Kiva's utopian ideology of entrepreneurial philanthropy. *Marketing Theory* 13: 3–18. <https://doi.org/10.1177/1470593112467265>.
- Balogun, I., E. Garner, P. Amer, P. Fennessy, B. Teeken, O. Olaosebikan, B. Abolore, T.U. Madu, B.C. Okoye, B. Santos, T. Byrne, D. Martin-Collado, C. Egesi, P. Kulakow, and H.A. Tufan. 2022. From traits to typologies: Piloting new approaches to profiling trait preferences along the cassava value chain in Nigeria. *Crop Science* 62: 259–274. <https://doi.org/10.1002/csc2.20680>.
- Barad, K. 2003. Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs* 28 (3): 801–831. <https://doi.org/10.1086/345321>.
- Barad, K. 2007. *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham: Duke university Press.
- Berik, G. 2017. Efficiency arguments for gender equality: An introduction. *Canadian Journal of Development Studies* 38 (4): 542–546. <https://doi.org/10.1080/02255189.2017.1377063>.
- Braidotti, R. 2021. *Posthuman feminism*. Cambridge: Polity Press.
- Byerlee, D., M. Collinson, D. Winkelmann, S. Biggs, E. Moscardi, J. C. Martinez, L. Harrington, and A. Benjamin. 1988 [1980]. *Planning technologies appropriate to farmers: Concepts and procedures*. Mexico: CIMMYT.
- Cairns, J.E., F. Baudron, K.L. Hassall, T. Ndhlela, I. Nyagumbo, S.P. McGrath, and S.M. Haeefe. 2021. Revisiting strategies to incorporate gender-responsiveness into maize breeding in Southern Africa. *Outlook on Agriculture*. <https://doi.org/10.1177/00307270211045410>.
- Callon, M., C. Méadel, and V. Rabeharisoa. 2002. The economy of qualities. *Economy and Society* 31 (2): 194–217. <https://doi.org/10.1080/03085140220123126>.
- Callon, M., Y. Millo, and F. Muniesa, eds. 2007. *Market devices*. Oxford: Blackwell.
- Carney, J., and M. Watts. 1990. Manufacturing dissent: Work, gender and the politics of meaning in a peasant society. *Africa* 60 (2): 207–241. <https://doi.org/10.2307/1160333>.
- Carney, J., and M. Watts. 1991. Disciplining women? Rice, mechanization, and the evolution of Mandinka gender relations. *Signs: Journal of Women in Culture and Society* 16 (4): 651–681.
- Carson, R. 1962. *Silent spring*. Boston: Houghton Mifflin.
- Ceccarelli, S., and S. Grando. 2007. Decentralized-participatory plant breeding: An example of demand driven research. *Euphytica* 155: 349–360. <https://doi.org/10.1007/s10681-006-9336-8>.
- Cernea, M.M., and A.H. Kassam, eds. 2005. *Researching the culture in agri-culture: Social research for international development*. Oxfordshire: CABI Publishing.
- CGIAR Gender and Breeding Initiative. 2017. Innovation in gender-responsive breeding: Workshop report. Nairobi, Kenya, October 5–7, 2017. Lima: CGIAR Gender and Breeding Initiative. https://cgspace.cgiar.org/bitstream/handle/10568/89834/GBI%20Workshop%20Report_17_12_13_shared%20WoC.pdf?sequence=1&isAllowed=y. Accessed 6 March 2022.
- CGIAR Science Council. 2007. Report of the first external review of the systemwide program on participatory research and gender analysis (PRGA). Rome: Science Council Secretariat. <https://www.fao.org/3/I0028e/I0028e00.pdf>. Accessed 11 October 2021.
- CGIAR System Council. 2018. CGIAR system 3-year business plan (2019–2021) companion document. Initiative on “Crops to End Hunger”: Strategy and options for CGIAR support to plant breeding. 7th CGIAR System Council meeting, 15–16 November 2018, Seattle, USA. https://storage.googleapis.com/cgiarorg/2018/11/SC7-B_Breeding-Initiative-1.pdf. Accessed 12 October 2021.
- CGIAR System Management Office. 2018. Modernizing CGIAR crop breeding programs: Draft 0 - 2019–2021 implementation plan. 11th CGIAR System Management Board meeting, 25 October 2018, Virtual. https://storage.googleapis.com/cgiarorg/2018/10/SMB11-03_Draft-0-Implementation-Breeding-Initiative.pdf. Accessed 11 October 2021.
- Chambers, R., A. Pacey, and L.A. Thrupp, eds. 1989. *Farmer first: Farmer innovation and agricultural research*. London: Practical Action Publishing.
- Chant, S., and C. Sweetman. 2012. Fixing women or fixing the world? ‘Smart economics’, efficiency approaches, and gender equality in development. *Gender & Development* 20 (3): 517–529. <https://doi.org/10.1080/13552074.2012.731812>.
- Cielemecka, O., and M. Szczygielska. 2019. Thinking the feminist vegetal turn in the shadow of Douglas-firs: An interview with Catriona Sandilands. *Catalyst: Feminism, Theory, and Technology* 5 (2): 1–19.
- Cobb, J.N., R.U. Juma, P.S. Biswas, J.D. Arbelaez, J. Rutkoski, G. Atlin, T. Hagen, M. Quinn, and E.H. Ng. 2019. Enhancing the rate of genetic gain in public-sector plant breeding programs: Lessons from the breeder's equation. *Theoretical and Applied Genetics* 132: 627–645. <https://doi.org/10.1007/s00122-019-03317-0>.
- Collins, A. 2016. ‘Empowerment’ as efficiency and participation: Gender in responsible agricultural investment principles. *International Feminist Journal of Politics* 18 (4): 559–573. <https://doi.org/10.1080/14616742.2016.1191791>.

- Collins, A. 2018. Saying all the right things? Gendered discourse in climate-smart agriculture. *Journal of Peasant Studies* 45 (1): 175–191. <https://doi.org/10.1080/03066150.2017.1377187>.
- Comaroff, J.L., and J. Comaroff. 2009. *Ethnicity, Inc.* Chicago: Chicago University Press.
- Cornwall, A., J. Gideon, and K. Wilson. 2008. Reclaiming feminism: Gender and neoliberalism. *IDS Bulletin* 39 (6): 1–9. <https://doi.org/10.1111/j.1759-5436.2008.tb00505.x>.
- Cornwall, A., and A.-M. Rivas. 2015. From ‘gender equality and ‘women’s empowerment’ to global justice: Reclaiming a transformative agenda for gender and development. *Third World Quarterly* 36 (2): 396–415. <https://doi.org/10.1080/01436597.2015.1013341>.
- Crossland, M., A.M.P. Valencia, T. Pagella, K. Mausch, D. Harris, L. Dilley, and L. Winowiecki. 2021. Women’s changing opportunities and aspirations amid male outmigration: Insights from Makueni County, Kenya. *The European Journal of Development Research* 33: 910–932. <https://doi.org/10.1057/s41287-021-00362-8>.
- De Haan, S., E. Salas, C. Fonseca, M. Gastelo, N. Amaya, C. Bastos, V. Hualla, and M. Bonierbale. 2019. *Participatory varietal selection of potato using the mother & baby trial design: A gender-responsive trainer’s guide.* Lima: International Potato Center.
- Doganova, L. 2020. What is the value of ANT research into economic valuation devices? In *The Routledge companion to actor-network theory*, eds. A. Blok, I. Fariás, and C. Roberts, 256–263. London: Routledge.
- Doganova, L., and M. Eyquem-Renault. 2009. What do business models do? Innovation devices in technology entrepreneurship. *Research Policy* 38 (10): 1559–1570. <https://doi.org/10.1016/j.respol.2009.08.002>.
- Doganova, L., and P. Karnøe. 2015. Building markets for clean technologies: Controversies, environmental concerns and economic worth. *Industrial Marketing Management* 44: 22–31. <https://doi.org/10.1016/j.indmarman.2014.10.004>.
- Doganova, L., and F. Muniesa. 2015. Capitalization devices. Business models and the renewal of markets. In *Making things valuable*, eds. M. Kornberger, L. Justesen, J. Mouritsen, and A.K. Maden, 108–125. Oxford: Oxford Scholarship Online.
- Dolan, C. 2001. The good wife: Struggles over resources in the Kenyan horticultural sector. *The Journal of Development Studies* 37 (3): 39–70. <https://doi.org/10.1080/00220380412331321961>.
- Donald, C.M. 1968. The breeding of crop ideotypes. *Euphytica* 17: 385–403. <https://doi.org/10.1007/BF00056241>.
- Doss, C. 2017. Including both equity and efficiency claims for international development. *Canadian Journal of Development Studies* 38 (4): 553–557. <https://doi.org/10.1080/02255189.2017.1376623>.
- Doss, C. 2018. Women and agricultural productivity: Reframing the issues. *Development Policy Review: The Journal of the Overseas Development Institute* 36 (1): 35–50. <https://doi.org/10.1111/dpr.12243>.
- Dzanku, F.M., D. Tsikata, and D.A. Ankrah. 2021. The gender and geography of agricultural commercialisation: What implications for the food security of Ghana’s smallholder farmers? *The Journal of Peasant Studies*. <https://doi.org/10.1080/03066150.2021.1945584>.
- EiB. 2018. Annual report 2017. https://excellenceinbreeding.org/sites/default/files/u107/EiB_AR-CGIAR%202017.pdf. Accessed 11 October 2021.
- EiB. 2019. Annual report 2018. https://excellenceinbreeding.org/sites/default/files/u107/EiB_AR-CGIAR%202018.pdf. Accessed 11 October 2021.
- EiB. 2021. Annual report 2020. https://excellenceinbreeding.org/sites/default/files/u1025/2020_EiB_AR_Final%2022%20July%202021.pdf. Accessed 5 March 2022.
- EiB. n.d. Crops to End Hunger. <https://excellenceinbreeding.org/CtEH>. Accessed 11 October 2021.
- Erenstein, O. 2012. Conservation agriculture-based technologies and the political economy: Lessons from South Asia. In *Contested agronomy: Agricultural research in a changing world*, eds. J. Sumberg, and J. Thompson, 47–63. London: Routledge.
- Esquivel, V. 2017. Efficiency and gender equality in growth theory: Simply add-ons? *Canadian Journal of Development Studies* 38 (4): 547–552. <https://doi.org/10.1080/02255189.2017.1377061>.
- FAO. 2011. *The state of food and agriculture: Women in agriculture: Closing the gender gap for development.* Rome: Food and Agriculture Organization of the United Nation.
- Farhall, K., and L. Rickards. 2021. The “gender agenda” in agriculture for development and its (lack of) alignment with feminist scholarship. *Frontier in Sustainable Food Systems*. <https://doi.org/10.3389/fsufs.2021.573424>.
- Farnworth, C.R., and J. Jiggins. 2003. *Participatory plant breeding and gender analysis.* Cali: Centro Internacional de Agricultura Tropical.
- Fejerskov, A.M. 2017. The influence of established ideas in emerging development organizations: Gender equality and the Bill and Melinda Gates Foundation. *Journal of Development Studies* 53: 584–599. <https://doi.org/10.1080/00220388.2016.1199859>.
- Fejerskov, A.M. 2018. Development as resistance and translation: Remaking norms and ideas of the Gates Foundation. *Progress in Development Studies* 18 (2): 126–143. <https://doi.org/10.1177/1464993417750287>.
- Ferguson, L. 2015. “This is our gender person”: The messy business of working as a gender expert in international development. *International Feminist Journal of Politics* 17 (3): 380–397. <https://doi.org/10.1080/14616742.2014.918787>.
- Fischer, K. 2022. Why Africa’s New Green Revolution is failing—Maize as a commodity and anti-commodity in South Africa. *Geoforum* 130: 96–104. <https://doi.org/10.1016/j.geoforum.2021.08.001>.
- Fisher, M., and E.R. Carr. 2015. The influence of gendered roles and responsibilities on the adoption of technologies that mitigate drought risk: The case of drought-tolerant maize seed in eastern Uganda. *Global Environmental Change* 35: 82–92. <https://doi.org/10.1016/j.gloenvcha.2015.08.009>.
- Fischer, E., and M. Qaim. 2012. Gender, agricultural commercialization, and collective action in Kenya. *Food Security* 4: 441–453. <https://doi.org/10.1007/s12571-012-0199-7>.
- Forsythe, L., A. Martin, and H. Posthumus. 2015. Cassava market development: A path to women’s empowerment or business as usual? *Food Chain* 5: 11–27. <https://doi.org/10.3362/2046-1887.2015.003>.
- Forsythe, L., H. Posthumus, and A. Martin. 2016. A crop of one’s own? Women’s experiences of cassava commercialization in Nigeria and Malawi. *Journal of Gender, Agriculture and Food Security* 1 (2): 110–128. <https://doi.org/10.22004/ag.econ.246033>.
- Forsythe, L., H.A. Tufan, A. Bouniol, U. Kleih, and G. Fliedel. 2021. An interdisciplinary and participatory methodology to improve user acceptability of root, tuber and banana varieties. *International Journal of Food Science & Technology* 56: 1115–1123. <https://doi.org/10.1111/ijfs.14680>.
- Friedmann, H. 1993. The political economy of food: A global crisis. *New Left Review* 197: 29–57.
- Friedmann, H., and P. McMichael. 1989. Agriculture and the state system. *Sociologia Ruralis* 29: 93–117.
- Fritz, G.J. 1999. Gender and the early cultivation of gourds in Eastern North America. *American Antiquity* 64 (3): 417–430. <https://doi.org/10.2307/2694142>.
- Frost, S. 2011. The implications of the new materialisms for feminist epistemology. In *Feminist epistemology and philosophy*

- of science: *Power in knowledge*, ed. H.E. Grasswick, 69–83. Dordrecht: Springer.
- Galié, A. 2013. Empowering women farmers: The case of participatory plant breeding in ten Syrian households. *Frontiers: A Journal of Women Studies* 34 (1): 58–92. <https://doi.org/10.5250/fronj womestud.34.1.0058>.
- Gates, M.F. 2014. Putting women and girls at the center of development. *Science* 345 (6202): 1273–1275. <https://doi.org/10.1126/science.1258882>.
- Gates, M.F. 2019. *A moment of lift: How empowering women changes the world*. New York: Flatiron Books.
- Gates Foundation. 2008. Gender impact strategy for agricultural development. <https://docs.gatesfoundation.org/documents/gender-impact-strategy.pdf>. Accessed 11 October 2021.
- Gates Foundation. 2012. Creating gender-responsive agricultural development programs – An orientation document. <https://docs.gatesfoundation.org/documents/gender-responsive-orientation-document.pdf>. Accessed 1 November 2021.
- Gates Foundation. n.d. Equal is greater. <https://www.gatesfoundation.org/equal-is-greater/>. Accessed 4 November 2021.
- Gengenbach, H., R.A. Schurman, T.J. Bassett, W.A. Munro, and W.G. Moseley. 2018. Limits of the New Green Revolution for Africa: Reconceptualising gendered agricultural value chains. *The Geographical Journal* 184: 208–214. <https://doi.org/10.1111/geoj.12233>.
- Haraway, D. 1997. *Modest_Witness@Second_Millennium.Female-Man@_Meets_Onco-Mouse™. Feminism and technoscience*. London: Routledge.
- Haraway, D. 2008. *When species meet*. Minneapolis: University of Minnesota Press.
- Harcourt, W., and I.L. Nelson, eds. 2015. *Practicing feminist political ecologies: Moving beyond the "Green Economy."* London: Zed Books.
- Haydon, S., T. Jung, and S. Russell. 2021. 'You've been framed': A critical review of academic discourse on philanthrocapitalism. *International Journal of Management Reviews* 23 (3): 1–23. <https://doi.org/10.1111/ijmr.12255>.
- Howard, P.L. 2003. *Women and plants. Gender relations in biodiversity management and conservation*. London: Zed Press and Palgrave-Macmillan.
- Ibabao, N. 2019. On the shoulders of giants, IRRI launches AGGRI Alliance. <http://news.irri.org/2019/03/on-shoulders-of-giants-irri-launches.html>, Accessed 5 March 2022.
- Jiggins, J. 1986. Gender-related impacts and the work of the international agricultural research centers. CGIAR Study Paper Number 17. Washington, DC: World Bank.
- Johnson, N., N. Lilja, J. Ashby, and J. Garcia. 2004. Practice of participatory research and gender analysis in natural resource management. *Natural Resources Forum Natural Resources Forum* 28: 189–200. <https://doi.org/10.1111/j.1477-8947.2004.00088.x>.
- Joshi, K.D., A.M. Musa, C. Johansen, S. Gyawali, and D. Harris. 2007. Highly client-oriented breeding, using local preferences and selection, produces widely adapted rice varieties. *Field Crops Research* 100 (1): 107–116. <https://doi.org/10.1016/j.fcr.2006.05.011>.
- Jost, C., F. Kyazze, J. Naab, S. Neelormi, J. Kinyangi, R. Zougmore, P. Aggarwal, G. Bhatta, M. Chaudhury, M.-L. Tapio-Bistrom, S. Nelson, and P. Kristjanson. 2016. Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate and Development* 8 (2): 133–144. <https://doi.org/10.1080/17565529.2015.1050978>.
- Kent, R. 2018. "Helping" or "appropriating"? Gender relations in shea nut production in Northern Ghana. *Society & Natural Resources* 31: 367–381. <https://doi.org/10.1080/08941920.2017.1382626>.
- Kherallah, M., C. Delgado, E. Gabre-Madhin, N. Minot, and M. Johnson. 2000. *The road half travelled: Agricultural market reform in Sub-Saharan Africa*. Washington, DC: International Food Policy Research Institute.
- Kimani, P. 2017. Principles of demand-led plant variety design. In *The business of plant breeding: Market-based approaches to new variety design in Africa*, eds. G.J. Persley, and V.M. Anthony, 1–25. Wallingford: CABI International.
- Kjellberg, H., and C.-F. Helgesson. 2007. On the nature of markets and their practices. *Marketing Theory* 7 (2): 137–162. <https://doi.org/10.1177/1470593107076862>.
- Korieh, C.J. 2007. Yam is king! But cassava is the mother of all crops: Farming, culture, and identity in Igbo agrarian economy. *Dialectical Anthropology* 31 (1): 221–232. <https://doi.org/10.1007/s10624-007-9022-9>.
- Korieh, C.J. 2010. *The land has changed: History, society and gender in colonial eastern Nigeria*. Calgary: University of Calgary Press.
- Law, J. 2009. Seeing like a survey. *Cultural Sociology* 3 (2): 239–256. <https://doi.org/10.1177/1749975509105533>.
- Law, J., and E. Ruppert. 2013. The social life of methods: Devices. *Journal of Cultural Economy* 6: 229–240. <https://doi.org/10.1080/17530350.2013.812042>.
- Lewis, D. 2001. African feminisms. *Agenda* 16 (50): 4–10. <https://doi.org/10.1080/10130950.2001.9675989>.
- Loevinsohn, M.E. 1987. Insecticide use and increased mortality in rural central Luzan. *The Lancet* 8546: 1359–1362. [https://doi.org/10.1016/S0140-6736\(87\)90659-3](https://doi.org/10.1016/S0140-6736(87)90659-3).
- Lyon, S., T. Mutersbaugh, and H. Worthen. 2019. Constructing the female coffee farmer: Do corporate smart-economic initiatives promote gender equity within agricultural value chains? *Economic Anthropology* 6: 34–47. <https://doi.org/10.1002/sea2.12129>.
- MacKenzie, D. 2009. *Material markets: How economic agents are constructed*. Oxford: Oxford University Press.
- MacKenzie, D., F. Muniesa, and L. Siu. 2007. *Do economists make markets? On the performativity of economics*. Princeton: Princeton University Press.
- Mashonganyika, T. R. 2018. Developing product replacement strategies. <https://excellenceinbreeding.org/sites/default/files/manual/Product%20Replacement%20Strategy%20Manual%20Oct%202018.pdf>. Accessed 1 November 2021.
- McCann, J.C. 2007. *Maize and grace. Africa's encounter with a New World crop, 1500–2000*. Cambridge: Harvard University Press.
- Mitchell, T. 2007. The properties of markets. In *Do Economists make markets? On the performativity of economics*, eds. D. MacKenzie, F. Muniesa, and L. Siu, 244–275. Princeton: Princeton University Press.
- Mohanty, C.T. 1984. Under Western eyes: Feminist scholarship and colonial discourses. *Boundary 2* (12/13): 333–358. <https://doi.org/10.2307/302821>.
- Mollett, S., and C. Faria. 2013. Messing with gender in feminist political ecology. *Geoforum* 45: 116–125. <https://doi.org/10.1016/j.geoforum.2012.10.009>.
- Moseley, W. 2021. Political agronomy 101: An introduction to the political ecology of industrial cropping systems. In *Political ecology of industrial crops*, eds. A. Ahmed, and A. Gasparatos, 25–44. London: Routledge.
- Moseley, W., M. Schnurr, and R. Bezner Kerr. 2015. Interrogating the technocratic (neoliberal) agenda for agricultural development and hunger alleviation in Africa. *African Geographical Review* 34 (1): 1–7. <https://doi.org/10.1080/19376812.2014.1003308>.
- Mutari, E. 2001. "...As broad as our life experience": Visions of feminist political economy, 1972–1991. *Review of Radical Political Economics* 33 (4): 379–399. [https://doi.org/10.1016/S0486-6134\(01\)00099-7](https://doi.org/10.1016/S0486-6134(01)00099-7).

- Nelson, V., K. Meadows, T. Cannon, J. Morton, and A. Martin. 2002. Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations. *Gender & Development* 10 (2): 51–59. <https://doi.org/10.1080/13552070215911>.
- NEPAD. 2016. Sustaining the CAADP momentum to spur agriculture transformation: Achieving Malabo targets through four thematic areas. Midrand: African Union Development Agency - New Partnership for Africa's Development. <https://www.nepad.org/publication/sustaining-caadp-momentum-spur-agriculture-transformation>. Accessed 11 October 2021.
- Njuki, J., S. Kaaria, A. Chamunorwa, and W. Chiuri. 2011. Linking smallholder farmers to markets, gender and intra-household dynamics: Does the choice of commodity matter? *The European Journal of Development Research* 23: 426–443. <https://doi.org/10.1057/ejdr.2011.8>.
- Nouvelle France Genetics. n.d. Client. *Nouvelle France Genetics*. <https://www.taylorfrancis.com/books/edit/10.4324/9780429351105/political-ecology-industrial-crops-abubakari-ahmed-alexandros-gasparatos?refId=1f48b6df-e7cb-4840-bb89-e1561b8ae473&context=ubx>. Accessed 23 February 2022.
- O'Laughlin, B. 2007. A bigger piece of a very small pie: Intra-household resource allocation and poverty reduction in Africa. *Development and Change* 38: 21–44. <https://doi.org/10.1111/j.1467-7660.2007.00401.x>.
- Orr, A., C. Cox, Y. Ru, and J. A. Ashby. 2018. Gender and social targeting in plant breeding. CGIAR Gender and Breeding Initiative Working Paper 1. Lima: CGIAR Gender and Breeding Initiative. https://cgspace.cgiar.org/bitstream/handle/10568/91276/Working%20Paper%201_STP_FINAL%20VERSION_18_02_08.pdf?sequence=1&isAllowed=y. Accessed 3 November 2021.
- Orr, A., S. Kee-Tui, T. Tsusaka, H. Msere, T. Dube, and T. Senda. 2016. Are there “women’s crops”? A new tool for gender and agriculture. *Development in Practice* 26 (8): 984–997. <https://doi.org/10.1080/09614524.2016.1226264>.
- Orr, A., V. Polar, and J. A. Ashby. 2021. User guide to the G+ customer profile tool (G+ CP). CGIAR Research Program on Roots, Tubers and Bananas, User Guide 2021-1. Lima: International Potato Center. <https://cgspace.cgiar.org/bitstream/handle/10568/113168/uscsp.pdf?sequence=1&isAllowed=y>. Accessed 1 November 2021.
- Padmanabhan, M.A. 2007. The making and unmaking of gendered crops in Northern Ghana. *Singapore Journal of Tropical Geography* 28 (1): 57–70. <https://doi.org/10.1111/j.1467-9493.2006.00276.x>.
- Persley, G.J., and V.M. Anthony, eds. 2017T. *The business of plant breeding: Market-based approaches to new variety design in Africa*. Wallingford: CABI International.
- Peterson, V.S. 2010. International/global political economy. In *Gender matters in global politics: A feminist introduction to international relations*, ed. L.J. Shepherd, 204–217. London: Routledge.
- Pimentel, D., and M. Pimentel. 1990. Comment: Adverse environmental consequences of the Green Revolution. *Population and Development Review* 16: 329–332. <https://doi.org/10.2307/2808081>.
- Pingali, P. 2012. The Bill & Melinda Gates Foundation: Catalyzing agricultural innovation. In *Scaling up in agriculture, rural development, and nutrition*, ed. J.F. Linn. Washington, DC: International Food Policy Research Institute.
- Pingali, P., and M. W. Rosengrant. 1994. Confronting the environmental consequences of the Green Revolution in Asia. EPTD Discussion Paper No. 2. Washington, DC: International Food Policy Research Institute.
- Pingali, P., D. Spielman, and F. Zaidi. 2016. Changing donor trends in assistance to agricultural research and development in Africa South of the Sahara. In *Agricultural research in Africa: Investing in future harvests*, eds. J. Lynam, N. Beintema, J. Roseboom, and O. Badiane, 139–170. Washington, DC: International Food Policy Research Institute.
- Polar, V., J. Ashby, G. Thiele, and H.A. Tufan. 2021. When is choice empowering? Examining gender differences in varietal adoption through case studies from Sub-Saharan Africa. *Sustainability* 13 (7): 3678. <https://doi.org/10.3390/su13073678>.
- Polar, V., B. Teeken, J. Mwendu, P. Marimo, H.A. Tufan, J. Ashby, S. Cole, S. Mayanja, J.J. Okello, P. Kulakow, and G. Thiele. 2022. Building demand-led and gender-responsive breeding programs. In *Root, tuber and banana food system innovation: Value creation for inclusive outcomes*, eds. G. Thiele, M. Friedmann, H. Campos, V. Polar, and J.W. Bentley, 483–509. Cham: Springer.
- Prügl, E., and S. Joshi. 2021. Productive farmers and vulnerable food securers: Contradictions of gender expertise in international food security discourse. *The Journal of Peasant Studies*. <https://doi.org/10.1080/03066150.2021.1964475>.
- Prügl, E., S. Razavi, and F. Reysoo. 2012. Gender and agriculture after neoliberalism. UNRISD workshop report. [https://www.unrisd.org/80256B3C005BCCF9%28httpAuxPages%29/389A79C59F53116EC1257BF8005219FA/\\$file/Gender%20and%20Agriculture%20after%20Neoliberalism%20%28small%29.pdf](https://www.unrisd.org/80256B3C005BCCF9%28httpAuxPages%29/389A79C59F53116EC1257BF8005219FA/$file/Gender%20and%20Agriculture%20after%20Neoliberalism%20%28small%29.pdf). Accessed 3 November 2021.
- Prügl, E., F. Reysoo, and D. Tsikata. 2021. Agricultural and land commercialization—Feminist and rights perspectives. *The Journal of Peasant Studies*. <https://doi.org/10.1080/03066150.2021.1974843>.
- Pyburn, R., and A. van Eerdewijk, eds. 2021. *Advancing gender equality through agricultural and environmental research—Past, present and future*. Washington, DC: IFPRI.
- Quisumbing, A.R., D. Rubin, C. Manfre, E. Waithanji, M. van den Bold, D. Olney, N. Johnson, and R. Meinzen-Dick. 2015. Gender, assets, and market-oriented agriculture: Learning from high-value crop and livestock projects in Africa and Asia. *Agriculture and Human Values* 32: 705–725. <https://doi.org/10.1007/s10460-015-9587-x>.
- Ragot, M., M. Bonierbale, and E. Weltzien. 2018. From market demand to breeding decisions: A framework. Lima: CGIAR Gender and Breeding Initiative. https://cgspace.cgiar.org/bitstream/handle/10568/91275/Working%20Paper%202_BreedingObjectives_FINAL%20VERSION_18_02_13.pdf?sequence=6&isAllowed=y. Accessed 3 October 2019.
- Rai, S.M., and G. Waylen, eds. 2014. *New frontiers in feminist political economy*. London: Routledge.
- Ramisch, J. 2012. ‘This field is our church’. The social and agronomic challenges of knowledge generation in a participatory soil fertility management project. In *Contested agronomy: Agricultural research in a changing world*, eds. J. Sumberg, and J. Thompson, 146–174. London: Routledge.
- Rankin, K.N. 2010. Governing development: Neoliberalism, microcredit, and rational economic woman. *Economy and Society* 30 (1): 18–37. <https://doi.org/10.1080/03085140020019070>.
- Rao, S., and C.D. Huggins. 2017. Sweet ‘success’: Contesting biofortification strategies to address malnutrition in Tanzania. In *Agronomy for development: The politics of knowledge in agricultural research*, ed. J. Sumberg, 104–120. London: Routledge.
- Razavi, S. 2002. *Shifting burdens: Gender and agrarian change under neoliberalism*. Bloomfield: Kumarian Press.
- Richards, P. 1985. *Indigenous agricultural revolution: Ecology and food crops in West Africa*. London: Hutchinson.
- Richey, L.A., and S. Ponte. 2014. New actors and alliances in development. *Third World Quarterly* 35 (1): 1–21. <https://doi.org/10.1080/01436597.2014.868979>.
- Roberts, A., and S. Soederberg. 2012. Gender equality as “smart economics”? A critique of the 2012 World Development Report.

- Third World Quarterly* 33 (5): 949–968. <https://doi.org/10.1080/01436597.2012.677310>.
- Rocheleau, D., and P. Nirmal. 2015. Feminist political ecologies: Grounded, networked and rooted on Earth. In *Oxford handbook of transnational feminist movements*, eds. R. Baksh, and W. Harcourt, 793–814. Oxford: Oxford University Press.
- Roman, G.G., and O.T. Westengen. 2022. Taking measure of an escape crop: Cassava relationality in a contemporary quilombo-remnant community. *Geoforum* 130: 136–145. <https://doi.org/10.1016/j.geoforum.2021.10.008>.
- Rousseau, K., D. Gautier, and D.A. Wardell. 2019. Socio-economic differentiation and shea globalization in western Burkina Faso: Integrating gender politics and agrarian change. *The Journal of Peasant Studies* 46 (4): 747–766. <https://doi.org/10.1080/03066150.2017.1401612>.
- Sachs, C., ed. 2019. *Gender, agriculture and agrarian transformation*. London: Routledge.
- Sachs, C., L. Jensen, P. Castellanos, and K. Sexsmith, eds. 2021. *Routledge handbook of gender and agriculture*. London: Routledge.
- Scoones, I., and J. Thompson, eds. 1994. *Beyond farmer first: Rural people's knowledge, agricultural research and extension practice*. Chippenham: Practical Action Publishing.
- Scoones, I., and J. Thompson, eds. 2009. *Farmer first revisited: Innovation for agricultural research and development*. Chippenham: Practical Action Publishing.
- Scott, J.C. 2009. *The art of not being governed: An anarchist history of upland Southeast Asia*. New York: Yale University Press.
- Scott, J.C. 2017. *Against the grain: A deep history of the earliest states*. New Haven: Yale University Press.
- Sorensen, P. 1996. Commercialisation of food crops in Busoga, Uganda and the renegotiation of gender. *Gender and Society* 10 (5): 608–628. <https://doi.org/10.1177/089124396010005007>.
- Sperling, L., J.A. Ashby, M.E. Smith, E. Weltzien, and S. McGuire. 2001. A framework for analyzing participatory plant breeding approaches and results. *Euphytica* 122 (3): 439–450. <https://doi.org/10.1023/A:1017505323730>.
- Spivak, G.C. 1988. Can the subaltern speak? In *Marxism and the interpretation of culture*, eds. C. Nelson, and L. Grossberg, 271–313. Champaign: University of Illinois Press.
- Star, S.L. 1990. Power, technology and the phenomenology of conventions: On being allergic to onions. *The Sociological Review* 38 (1): 26–56. <https://doi.org/10.1111/j.1467-954X.1990.tb03347.x>.
- Sumberg, J., J. Heirman, C. Raboanarielina, and A. Kaboré. 2013a. From agricultural research to 'product development': What role for user feedback and feedback loops? *Outlook on Agriculture* 42 (4): 233–242. <https://doi.org/10.5367/oa.2013.0144>.
- Sumberg, J., R. Irving, E. Adams, and J. Thompson. 2012b. Success-making and success stories: Agronomic research in the spotlight. In *Contested agronomy: Agricultural research in a changing world*, eds. J. Sumberg, and J. Thompson, 186–203. London: Routledge.
- Sumberg, J., and D. Reece. 2004. Agricultural research through a 'new product' development lens. *Experimental Agriculture* 40: 295–314. <https://doi.org/10.1017/S0014479704002030>.
- Sumberg, J., and J. Thompson, eds. 2012. *Contested agronomy: Agricultural research in a changing world*. London: Routledge.
- Sumberg, J., J. Thompson, and P. Woodhouse. 2012a. Contested agronomy: Agricultural research in a changing world. In *Contested agronomy: Agricultural research in a changing world*, eds. J. Sumberg, and J. Thompson, 1–21. London: Routledge.
- Sumberg, J., J. Thompson, and P. Woodhouse. 2013b. Why agronomy in the developing world has become contentious. *Agriculture and Human Values* 30: 71–83. <https://doi.org/10.1007/s10460-012-9376-8>.
- Tapia, M.E., and A. De la Torre. 1998. *Women farmers and Andean seeds*. Washington, DC: International Plant Genetic Resources Institute.
- Tavener, K., M. van Wijk, S. Fraval, J. Hammond, I. Baltenweck, N. Teufel, E. Kihoro, N. de Haan, J. Van Etten, J. Steinke, D. Baines, P. Carpena, T. Skirrow, T. Rosenstock, C. Lamanna, M. Ngendo, S. Chesterman, N. Namoi, and L. Manda. 2019. Intensifying inequality? Gendered trends in commercializing and diversifying smallholder farming systems in East Africa. *Frontiers in Sustainable Food Systems*. <https://doi.org/10.3389/fsufs.2019.00010>.
- Taylor, M., R. Bargout, and S. Bhasme. 2021. Situating political agronomy: The knowledge politics of hybrid rice in India and Uganda. *Development and Change* 52 (1): 168–191. <https://doi.org/10.1111/dech.12605>.
- Teeken, B., E. Garner, A. Agbona, I. Balogun, O. Olaosebikan, A. Bello, T. Madu, B. Okoye, C. Egesi, P. Kulakow, and H.A. Tufan. 2021. Beyond "women's traits": Exploring how gender, social difference, and household characteristics influence trait preferences. *Frontiers in Sustainable Food Systems*. <https://doi.org/10.3389/fsufs.2021.740926>.
- Thiele, G., D. Dufour, P. Vernier, R.O.M. Mwanga, M.L. Parker, E.S. Geldermann, B. Teeken, T. Wossen, E. Gotor, E. Kikulwe, H.A. Tufan, S. Sinelle, A. Kouakou, M. Friedmann, V. Polar, and C. Hershey. 2021. A review of varietal change in roots, tubers and bananas: Consumer preferences and other drivers of adoption and implications for breeding. *International Journal of Food Science & Technology* 56 (3): 1076–1092. <https://doi.org/10.1111/ijfs.14684>.
- Tongoona, P., A. Danquah, and E.Y. Danquah. 2017. Understanding clients' needs. In *The business of plant breeding: Market-based approaches to new variety design in Africa*, eds. G.J. Persley, and V.M. Anthony, 63–84. Wallingford: CABI International.
- Valencia-Fourcans, L., and R. Hawkins. 2016. Representations of women in microcredit promotional materials: The case of Espoir Ecuador. *Journal of International Development* 28: 507–527. <https://doi.org/10.1002/jid.3136>.
- van der Burg, M. 2019. "Change in the making": 1970s and 1980s building stones to gender integration in CGIAR agricultural research. In *Gender, agriculture and agrarian transformations: Changing relations in Africa, Latin America and Asia*, ed. C.E. Sachs, 35–56. London: Routledge.
- Voss, R.C., J. Donovan, P. Rutsaert, and J.E. Cairns. 2021. Gender inclusivity through maize breeding in Africa: A review of the issues and options for future engagement. *Outlook on Agriculture* 50 (4): 392–405. <https://doi.org/10.1177/00307270211058208>.
- Weltzien, E., F. Rattunde, A. Christinck, K. Isaacs, and J.A. Ashby. 2019. Gender and farmer preferences for varietal traits: Evidence and issues for crop improvement. In *Plant breeding reviews*, ed. I. Goldman, 243–278. Hoboken: Wiley.
- Westengen, O.T., P. Nyanga, D. Chibamba, M. Guillen-Royo, and D. Banik. 2018. A climate for commerce: The political agronomy of conservation agriculture in Zambia. *Agriculture and Human Values* 35: 255–268. <https://doi.org/10.1007/s10460-017-9820-x>.
- Whitfield, S. 2016. *Adapting to climate uncertainty in African agriculture. Narratives and knowledge politics*. London: Routledge.
- Wilson, K. 2011. 'Race', gender and neoliberalism: Changing visual representations in development. *Third World Quarterly* 32 (2): 315–331. <https://doi.org/10.1080/01436597.2011.560471>.
- Wilson, K. 2015. Towards a radical re-appropriation: Gender, development and neoliberal feminism. *Development and Change* 46 (4): 803–832. <https://doi.org/10.1111/dech.12176>.
- Woodhouse, P. 2012. Water in African agronomy. In *Contested agronomy: Agricultural research in a changing world*, eds. J. Sumberg, and J. Thompson, 102–115. London: Routledge.

- World Bank. 2006. Gender equality as smart economics: A World Bank group gender action plan (Fiscal Years 2007–2010). Washington, DC: The World Bank. <http://siteresources.worldbank.org/INTGENDER/Resources/GAPNov2.pdf>. Accessed 2 November 2021.
- World Bank. 2012. World Development Report 2012: Gender equality and development. Washington, DC: The World Bank. <https://openknowledge.worldbank.org/handle/10986/4391>. Accessed 11 November 2021.
- World Bank, FAO, and IFAD. 2009. *Gender in agriculture sourcebook*. Washington, DC: World Bank.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ida Arff Tarjem is a Ph.D. Fellow at the Department of International Environment and Development Studies, Faculty of Landscape and Society, Norwegian University of Life Sciences (NMBU). She holds a B.Sc. in Biology from the University of Bristol, UK, and a M.Sc. in Biotechnology from NMBU, with a specialisation in plant biotechnology. She works at the interface of plant breeding and gender using perspectives from political agronomy, feminist science and technology studies and critical plant studies.

Ola Tveitereid Westengen is an Associate Professor at the Department of International Environment and Development Studies, Faculty of Landscape and Society, Norwegian University of Life Sciences (NMBU). He works on the intersections of science and policy research on crop diversity and seed systems. Westengen recently co-edited *Farmers and plant breeding: Current approaches and perspectives* (Routledge 2020).

Poul Wisborg is an Associate Professor at the Department of International Environment and Development Studies, Faculty of Landscape and Society, Norwegian University of Life Sciences (NMBU). He holds a M.Sc. in Management of Natural Resources and Sustainable Agriculture (NMBU) and a Ph.D. in International Environment and Development Studies (NMBU). His research interests include land, social justice, human rights, gender and development.

Katharina Glaab is an Associate Professor at the Department of International Environment and Development Studies, Faculty of Landscape and Society, Norwegian University of Life Sciences (NMBU). She holds a Ph.D. in Political Science from the University of Münster, Germany. Her work revolves around questions of norms and governance and their adaptation to ecological and technological change particularly in the field of genetically modified foods.