

Gender and Promoting Quality Seeds in Africa

A Literature Review

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Gender and Promoting Quality Seeds in Africa: A Literature Review

Emily Brearley* and Berber Kramer†

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Abstract

Advances in plant breeding and biotechnology have the potential to transform agriculture in Africa, but sustainable and inclusive distribution and marketing of quality seeds remains a significant challenge. We review the peer-reviewed literature on alternative approaches for promoting improved varieties and quality seeds in Africa, focusing on how adoption and use can be enhanced for women and men alike. The analysis explores a range of innovations that have been developed in recent years with the aim to boost the availability and quality, access to and, control and use of seeds. The literature review highlights pockets of innovative models on both the public and private sector side. However, many of these approaches are not tested with a gender lens. In fact, many innovations risk increasing productivity for a small segment of the farming population, thereby potentially further widening the large gender gaps in empowerment in agriculture. Given the current understanding of intra-household gender dynamics and contextual crop-specific constraints across the value chain, there is an urgent need to start testing, measuring and documenting both the sustainability and inclusiveness of alternative innovations to promote the use of high-quality seeds.

Keywords: Gender, Seed systems, Seed delivery, Literature review, Africa

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Section 1. Introduction

Advances in plant breeding and biotechnology have had unprecedented impacts on crop productivity and well-being in Asia and Latin America; with the potential to adapt these approaches to accelerate gains in food security and reduce poverty in Sub-Saharan Africa (Arouna *et al.*, 2017; Evensen and Gollin, 2003; Maredia *et al.*, 2000). Improving African farmers' access to improved varieties has become even more important in the face of climate change, with current varieties and germplasm—evolved through centuries of breeding and seed selection—not yet adequately adapted to rising temperatures and more frequently occurring weather extremes (Lobell *et al.*, 2009). To enhance agricultural productivity and resilience from external stressors (such as drought, floods, pests and disease), the international agricultural development community has embraced the development of new varieties, along with the conservation, exchange and use of existing diversity in genetic materials, as some of its central priorities.

While great strides are being made on the variety development side, the marketing and distribution of those varieties remains a significant challenge. Many varieties that can enhance productivity or reduce exposure to external stressors are not adopted at scale by smallholder farmers (Eriksson *et al.*, 2018). Varieties stay on the shelf at research stations because they do not meet farmers' needs, because farmers lack information, or because the seeds of these varieties are not being produced (ISSD Africa, 2017). Further, in many countries, distribution channels for high-quality seeds comes with implicit blind spots and gender biases. Formal seed systems are often too narrow and not pro-poor, focusing on the needs of richer farmers to the detriment of the most in need (Dawson, 2016). Common approaches to increase the use of improved varieties, including government extension and formal seed retail channels, are often biased towards large farming operations, without considering ways in which enhanced seed technologies can reach, benefit and empower the diversity of women and men involved in smallholder farming. Meanwhile, farmer-preferred local varieties are often neglected in seed systems interventions.

In this paper, we review the literature on different innovations and models for promoting the use of high-quality seeds—including both improved seeds and farmer-preferred local varieties—in Sub-Saharan Africa. Although across Africa, women account for a large share of the agricultural labor force, their crop productivity is lower than men's, and reasons for this are rooted in different

dimensions of empowerment (Quisumbing *et al.*, 2019). Women tend to have less secure land tenure and access to inputs and other assets, and there is a large gender gap in access and use of financial services and technologies such as mobile phones. Social norms still dictate that men should control cash crops, which are the focus of agricultural policies, whereas the promotion of “women’s crops” and nutrition are seen as secondary objectives—although studies outlined below show that gender roles in practice are more blurred than in theory. Persistent gender gaps are also observed in political governance and representation, agricultural research and innovation systems, and in other positions of influence in many African countries.

Innovations in seed systems should benefit from the well-trod path outlined by Esther Boserup in the 1970s, and thus at the least not undermine women’s empowerment; ideally supporting interventions that actively address gender gaps. This could be achieved for example, by: enhancing the quality and traits of improved varieties so that they meet the needs and preferences of both women and men; by reducing gender gaps in access to information on how to use these improved varieties; by improving women’s control over seeds and associated benefits, such as the income from selling seeds or crops produced using those seeds; and by establishing female-led business models to create new business opportunities for the production and distribution of quality seeds of improved and farmer-preferred varieties; all which could influence gender dynamics and reduce empowerment gaps at the intra-household level. To change social norms and bridge gender gaps, investments of time and resources will however be needed to engage with community leaders and policymakers (Quisumbing *et al.*, 2019).

The goal of this review is therefore to gauge the extent to which a gender lens has been applied in seed delivery programs; by summarizing the available literature on different innovations and models for promoting the use of high-quality seed for both improved and farmer-preferred varieties in Sub-Saharan Africa. Our definition of the term “innovation” is inclusive. It encompasses all interventions that seek to improve on what was there before, overcoming any of the many and complex ways in which the public or private sectors may have failed to address farmers’ needs, especially those of smallholders—both male and female—located in remote areas with limited purchasing power. In studying these innovations, we aim to address two research questions: (i) which innovations are *sustainable*, in that gains outweigh costs from the perspective of seed businesses, resulting in cost-effective business models (‘increasing the size of the pie’); and (ii) to

what extent these innovations are *inclusive*, in that they empower female farmers and address gender inequality in seed systems (‘dividing the pie more equally’).

This literature review was designed to capture those interventions that aim to do things differently in promoting the use of high-quality seeds that meet the needs and preferences of both women and men in Africa. This review analyzes whether innovations in seed systems have indeed improved the sustainability and inclusivity of seed delivery. Is the current focus of innovative business models to enhance the use of high-quality seeds and thereby boost agricultural productivity sufficient to achieve gender equality? Or is a broader approach, including efforts to shift gender norms, needed in order to create a more enabling environment for women to participate in agricultural value chains and benefit from innovations in seed systems as much as men?

The following sections outline the methodological framework; present findings from the literature review; and, finally, discuss areas for further innovation and experimentation. Through the literature review, we found pockets of innovative models for seed delivery on both the public and private sector side. However, we also established that much of the peer-reviewed literature on these approaches does not adopt a gender lens. Promising approaches that considered gender in the design or analyses remain in the experimental stage. This is problematic since innovations not designed with a deeper understanding of intra-household dynamics could risk increasing crop productivity without empowering women—and in some instances, make women farmers worse off. Given our existing knowledge of the extreme importance of intra-household gender dynamics, contextual crop-specific constraints across the value chain, and innovative technologies and approaches with proven track records, there is an urgent need to rethink seed delivery and test which innovative business models can make seed systems work for all farmers.

Section 2. Methodology

We systematized the literature review of seeds delivery systems through a two-step analytical framework to: i) gauge the type of innovations in seed delivery that have been developed and tested in recent years, particularly in terms of how they helped improve agricultural productivity, profitability and incomes (i.e., to what extent these innovations have increased the size of the pie); and ii) determine whether, and the extent to which, the innovation had an impact on female

empowerment (i.e., a more equal division of the pie). Where the reviewed articles did not include a gender analysis, the review suggests ways in which this could be achieved.

Specifically, the framework was developed by combining well-known concepts of seed security and associated outcomes with concepts from the literature on gender and empowerment. In applying the framework, we focused on different actors and socio-economic groups that distribute and use seed. The framework links four potential seed systems outcomes—an approach that is derived from Remington *et al.* (2002), Sperling *et al.* (2008), McGuire and Sperling (2011), Sperling *et al.* (2013), FAO (2015), Subedi and Vernooy (2019), which all draw on the concepts of seed security and associated outcomes, and from RTB (2016) and Bentley *et al.* (2018) on multi-stakeholder institutional frameworks for intervening in seed systems. These four outcomes are:

- **Availability** (supply side: having enough seed physically present at the right time and place and of the preferred varieties. This also captures delivery mechanisms);
- **Quality** (includes both physical seed qualities—e.g. size, weight, color, and appropriateness—and genetic quality, i.e. the variety; as determined by various actors using formal and non-formal methods with varied degrees of rigor);
- **Access** (demand side: the capacity to obtain reliable information about how and where to obtain quality seed of the right varieties, its price and how best to use it. This is influenced by the mobility and networks of seed users);
- **Use and control** (the extent to which farmers have the requisite skills to use the technology, and the intra-household dynamics that impact usage).

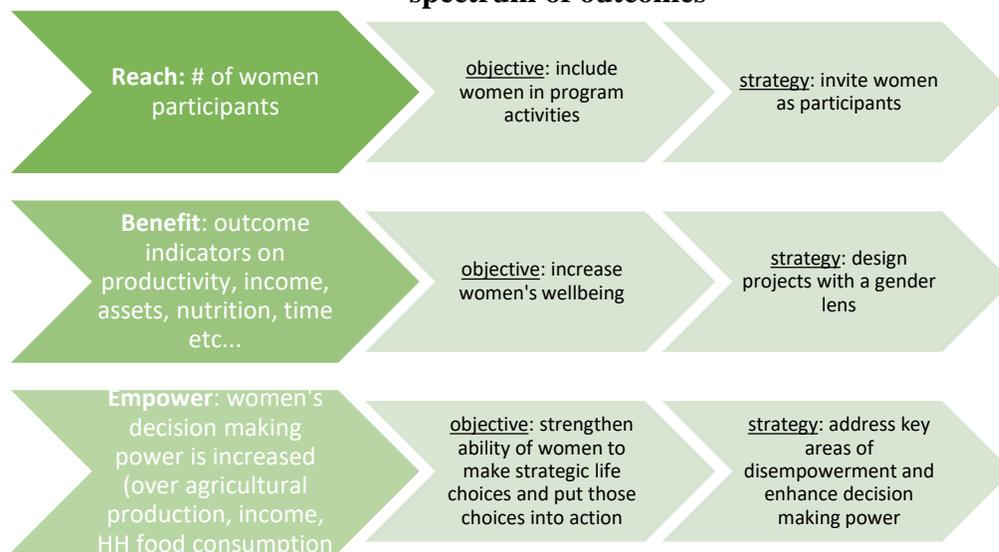
To gauge which interventions in seed systems “empowered” women, we adopted a 3-step framework for gender outcomes from Johnsen *et al.* (2018).¹ This framework was developed to help clarify the objectives of agriculture development projects, and to show how outcomes for women tend to accumulate along a path characterized by three major steps: reaching women with an intervention (reach); increasing outcome indicators such as income or productivity (benefit);

¹ Johnson et al. 2018. How do agricultural development projects empower women? Linking strategies with expected outcomes. *Journal of Gender, Agriculture and Food Security* Volume 3, Issue 2, 2018. pp 1-19
<https://ageconsearch.umn.edu/record/293596/>

and, finally, changing gender norms and decision-making processes, thus increasing women’s decision-making power (empower).

The literature review sought to cast a wide net—to capture all potential innovations in seed delivery that impact women. An initial search incorporated peer reviewed journal articles collected through a community of practice for research on gender in seed systems, led by the CGIAR Collaborative Platform for Gender Research; this was then expanded to a general search in Google Scholar using a set of predefined keywords. Search terms for inclusion were: Women’s empowerment, agricultural development, agricultural extension, seeds, seed distribution, gender, monitoring and evaluation; while search terms for exclusion limited the scope to interventions in sub-Saharan Africa. Note that the focus was not on innovations in seed “science”—i.e. biological development or production, but on the distribution and marketing component of seed systems. Studies using both qualitative and quantitative methods were included across a number of disciplines within social science (development economics, agriculture, business studies and anthropology). In addition to these academic contributions, the review also captured non-academic contributions where relevant. Where search words omitted relevant innovations of which we were already aware, we included these innovations in our search terms.

Figure 1: A Framework to clarify how agriculture projects empower women across a spectrum of outcomes



Source: Adapted from Johnson *et al.* 2018. The combination of these two systems of analysis were combined to create our analytical framework.

After a review of abstracts from all articles derived through our search (approximately 200 articles), in total, eighty-nine (89) sources were considered relevant and coded in terms of the following details, out of which 47 provided innovations or relevant insights that were discussed in this review (see Tables 1 and 2):

- Summary (evidence of sustainability; evidence of inclusivity; method through which evidence was obtained)
- Observed Pathways to Improved Outcomes
 - Level of Seed Intervention (*availability, quality, access, use and control*)
 - Women's Empowerment (*Reach, Benefit, Empowerment*)
- Type of intervention (summary of seed systems outcomes targeted by intervention)²

Section 3. Findings

Today, in most countries in Sub-Saharan Africa, the seed sector is characterized by hybrid systems within which a broad range of public and private, and formal and informal institutions all operate, both with their own failures and successes. For example, problems in extension systems have occurred due to a combination of a lack of availability of quality seed, difficulties reaching the most needy farmers across vast geographic areas, and weak connections between National Agricultural Research Systems (NARs), extension agents and farmers (Davis, 2008). Commercial enterprises have faced challenges in marketing seeds to smallholder farmers, for instance because farmers purchasing seed of a new variety tend to re-sow from their own harvests for a number of years, in lieu of purchasing new seeds every year, affecting seed enterprise profitability (David and Sperling 1999). Hence, many seed companies focus on hybrid varieties of crops like maize and vegetables, for which farmers have to purchase new seed every year in order to sustain crop productivity, instead of open-pollinated varieties of crops such as rice, sorghum and beans, for which seed can be reproduced by farmers themselves, creating a more complicated business case.

The sources reviewed in this section can be roughly divided into these two broad categories, with the first set of sources focused on promoting quality seed of improved varieties through the public

² We focused not only on interventions to promote improved varieties, but also on varietal turnover. Replacing an improved variety with a more recent variety is often neglected as a seed policy objective but is important as it can help sustain yield gains over time, protect those gains from biotic and abiotic stresses, enhance the crop's use of scarce natural resources, and improve output quality (Spielman and Smale, 2017).

sector, particularly innovations in government extension programs, input subsidy programs and quality assurance to promote quality seeds. A second set of sources focuses on how the private sector operates in seed systems—predominantly focusing on “bottom of the pyramid”, civil society approaches that seek to empower local farmer groups or community seed groups; with the literature on private commercial seed companies being more sparse.³ For both sectors, we discuss findings on the sustainability and inclusivity of new approaches that aim to enhance availability, quality, access, and use and control for quality seeds, focusing on the public sector in Section 3.1, and on the private sector in Section 3.2.

3.1 Public sector innovations for enhanced seed systems outcomes

An important component through which governments promote improved varieties is the extension system. Although public extension efforts have been much critiqued in the past for failing to reach those farmers who need them most (Davis, 2008), extension systems constitute a key role in the seed delivery chain. Governments use extension systems to channel technologies that are developed and enhanced through (state-funded) research, that is, varieties developed through public breeding programmes, without having to rely solely on the commercial sector. When carefully designed, extension systems can play a critical role in technology diffusion and lead to faster consumption growth and lower rates of poverty (see for example Dercon *et al.* 2009).

We reviewed 30 sources to find innovations in the ways through which the public sector promotes quality seeds (see Table 1). An encouraging observation was that most of these sources considered multiple seed systems outcomes (from Figure 2: availability, quality, access, and use and control); and not only in isolation, but also considering how these outcomes can complement each other. At the same time, most sources *critiqued* existing interventions, with only 16 of the 30 reviewed sources testing an innovation in promoting seeds, and only 5 of these discussing issues around sustainability. This limits insights on cost-effective innovations to enhance farmers’ access, use and control over high-quality seeds. Further, as also noted in earlier studies (Mudege and Torres, 2017; Mudege *et al.*, 2016a, 2015), we lament the general lack of availability of gender

³ While we acknowledge that the range of policy options to promote varietal turnover is broader, including the streamlining of varietal registration procedures, early-generation seed provision, enhancing seed enterprises’ marketing capabilities, and establishing antitrust policy to encourage innovation in the private sector (Spielman and Smale, 2017), we did not find literature on the effects of these alternative policy options.

disaggregated statistics for extension services for seed delivery, particularly in terms of measuring benefits and empowerment (analyzed for only 7 and 2 of the 16 reviewed innovations, respectively).

While most studies do not point the way towards gender-responsive approaches in seed delivery extension systems, there are lessons to be learnt from what did not work in the past, as well as a few bright spots of innovation. We will discuss three sets of innovations: advances in extension messaging, including interesting advances in terms of technology and improved psychological approaches based on how people learn and best retain and use information; improving access to seeds by providing credit, subsidies, vouchers or cash, sometimes bundled with extension; and seed quality assurance schemes.

Gender and extension to improve seed systems outcomes

Many papers focused on the generalized failure of extension systems to *reach* women at all, limiting their benefits from government efforts to improve agricultural productivity. In Ethiopia, extension advice and access to a radio are both strongly and positively related to the adoption of improved varieties and fertilizer for both women and men; but women are less likely to receive extension services—and also less likely to access quality services—than their male counterparts (Ragasa *et al.*, 2013). Similarly, Gilbert *et al.* (2002) and Theriault *et al.* (2017) find that extension services in Malawi and Burkina Faso are biased towards men. In Rwanda, Nahayo *et al.* (2017) find that women are less likely to self-select into the Ministry of Agriculture’s ‘crop intensification program’ (CIP), with the risk of the program widening gender gaps in productivity.

Other papers examined mechanisms through which women might not *benefit* as much from extension services as men. Panel data in Uganda show that self-learning from past technology adoption—cited as the main determinant of current technology adoption—has a weaker impact for female-headed compared to male-headed households (Mishra *et al.*, 2020); meaning that inclusive extension programs can potentially benefit women by creating both current learning opportunities for technology adoption, and self-learning opportunities that will help sustain future technology adoption. In Malawi, underlying gender norms in household decision-making mediated access to extension, whereby male potato farmers regarded themselves as representatives of their households in trainings and, to some extent, extension officers reinforced these views by using

biased training recruitment methods (Mudege *et al.*, 2016b). Innovations that address gender norms could improve women’s ability to participate in training and help build agency in decisions regarding the adoption, use and control of seeds, which in turn could create self-learning opportunities to spur future technology adoption.

A few studies tested new approaches in delivering extension and found that impacts depend on the quality of information and the way in which it is delivered. For example, combining input subsidies for seed and fertilizer with “good advice” (as perceived by farmers) can increase productivity, with a limited effect discerned in the absence of good advice (Ragasa and Mazunda, 2018). Adding a few days of centralized training to a decentralized training on a new technology improves retention and use of information by extension officers (Kondylis *et al.*, 2017). BRAC’s extension program for women smallholder farmers in Uganda trains model farmers from the targeted population instead of trying to reach *all* women through extension officers. Providing information through these local model farmers led to enhanced cultivation practices including the use of quality seeds, with positive effects on food security and the ability to cope with shocks (Pan *et al.*, 2018). Farmers in a study in Malawi needed several information sources to relax risk and information constraints and induce the adoption of improved varieties (Beaman *et al.*, 2018).

A particularly innovative approach delivers extension even to remote geographical areas, by means of ‘edutainment’ or video-based messaging. In Kenya, the makeover reality TV show *Shamba Shape Up!*—in which a male and female television presenter address common issues faced by smallholder farmers on their plots and fix them in a 30-minute episode—helped set the agenda for discussions within farming communities about opportunities to enhance farmers’ lives, while the TV show also directly gave specific ideas, information and knowledge to enhance productivity.⁴ As in the local model farmer approach, these influences were driven by a strong demonstration effect, but also by empathy with the featured farmers, the interaction with credible experts and the stimulation of discussion from the show (Clarkson *et al.*, 2019). In Uganda, the delivery of extension video messages through tablets significantly increased farmers’ knowledge of new

⁴ Shamba Shape Up! builds on the concept of farm field schools, which aimed to replace extension systems with intensive, season-long teaching programs where farmers would meet weekly to learn and experiment on a given topic (see for example Anandajayasekera *et al.* 2007).

technologies, as well as triggering a process of abstraction, whereby farmers applied insights gained in one context to a different context (Van Campenhout *et al.*, 2020).

Whilst none of the above studies testing innovations adopted an explicit gender lens, a few studies highlight the importance of measuring gender gaps in extension outcomes, even when there is no gender-sensitive programming, to ascertain that an innovation does not further widen gender gaps. In some cases, extension efforts did not benefit women at all, and worse, were found to harm women's empowerment. In Uganda, the introduction of NERICA, an improved rice variety, disempowered women due to the added labor burden of bird scaring and weeding (Bergman Lodin *et al.*, 2012). Similarly, in Ethiopia, an extension service focused on the adoption of Sustainable Agricultural Practices (SAPs) increased women's workload (Teklewold *et al.*, 2013). More recent research suggests that women are less likely to benefit from climate change resistant crops that have been promoted through the extension system due to intra-household differentials in endowments of resources including land, credit and social capital; but also due to differences in the *returns* to resources (Teklewold *et al.*, 2020).

On the bright side, we also found sources discussing interventions that worked, were innovative, and often had a gender lens. Many of these used participatory approaches. Njuguna *et al.* (2016) piloted the use of role plays in Ethiopia to improve dialogue, and challenge gender norms that prevent women from fully benefitting from extension uptake. Oumer *et al.* (2014) use qualitative methods to show how *Farmers Research Groups (FRGs)* in Ethiopia—set up by the government—addressed gender inequalities by providing women with practical agricultural skills, knowledge of new technologies and the ability to assess input and output markets. In addition, women's decision making *within* households was also enhanced. Mudege *et al.* (2015b) suggests that there is similar potential for gender inclusive FRGs in Malawi but does not test the hypothesis.

Although not testing a participatory approach per se, Lecoutere *et al.* (2019) provide a good example of using technology to face gender gaps in extension head on, rather than keeping messages implicit. Using video-enabled extension messages about improved management practices for maize producers in Uganda, this study randomized whether videos were shown to women, men, or couples, and whether they featured male, female, or both male and female actors (or role models). Targeting women in the screening of these videos directly empowered them, not

only by enhancing their knowledge, but also by strengthening their role in agricultural decision-making, with increased adoption of recommended practices and inputs, improved production-related outcomes, and increased market sales. The videos had these effects by helping overcome intra-household information asymmetries.⁵

Input subsidy programs and other resource transfers

A second set of innovations directly improve access to seeds through free delivery, subsidy vouchers, or other resource transfers; either in isolation or in the context of an extension program. Several studies analyzed the effects of bundling the delivery of extension messages with efforts to increase availability of and access to quality seeds. In Ethiopia, Abate *et al.* (2018) evaluate a packaged intervention that provided certified seeds on credit along with complementary inputs, information on how to improve techniques, and market guarantees for farmers' output. This program increased wheat yields among male farmers by 14 percent. In terms of seed systems outcomes, effects were primarily driven by enhanced access to quality seeds and complementary inputs, and to some extent by the information to start row sowing and reduce seeding rates, resulting in a better use of those seeds. However, the program did not improve yields as much as envisioned based on agronomic trials, which could threaten the sustainability of this approach. Further, despite explicitly including women as model farmers (*reach*), the program had significantly lower *benefits* for women, as yield improvements were lower for female model farmers than for their male counterparts.

BRAC's extension program in Uganda targeting women smallholder farmers, packaged the provision of information on improved cultivation practices with the commercialization of yield-enhancing maize varieties through local village entrepreneurs. Local farmers from the target population could obtain these seeds at a reduced price and sell on to other farmers in their communities. Engaging women farmers to increase access to quality seeds increased adoption of the BRAC varieties (Pan *et al.*, 2020), although by replacing other improved varieties that farmers were using in the absence of BRAC seed availability, and thus not changing overall adoption of improved varieties. Nevertheless, this innovation may have enhanced the quality of seeds used by farmers, due to existing concerns around counterfeiting and limited quality control in local

⁵ Variation in the gender of actors led to mixed results. Lecoutere *et al.* (2019) hence argue that subtle means to influence perceptions and norms about gendered roles in the household may not generate expected effects.

markets. In contrast to the Ethiopia package (Abate *et al.*, 2018), BRAC's package appears to have impacted production and food security largely by providing information and shifting cultivation practices (affecting the *use* of the seeds), and by promoting the use of quality seeds, rather than by providing improved varieties per se.

Neither of these studies analyze the causal effect and cost-effectiveness of including the provision of inputs as a physical transfer of resources within the extension packages, since each component is offered to all beneficiary households. To identify the factors constraining improved access to and use and control over seeds, one would want to isolate the effects of such resource transfers, which could include subsidized inputs, vouchers or cash.

A nationwide government program that provided subsidies for hybrid maize seed in Zambia enhanced smallholder farmers' household income, with high private and social benefit-cost ratios, but these subsidies did not reduce gender income inequality (Mason and Smale, 2013). Likewise, while some find that receiving a subsidy in Malawi's Farm Input Subsidy Program (FISP)—which aimed to target female household heads—increased the probability of modern maize cultivation among women by 222% (Fisher and Kandiwa, 2015), other evidence indicates that seed subsidies did not reach or benefit women more than men; and that seed subsidies were unsustainable, crowding out commercial seed purchases (Mason and Ricker-Gilbert, 2013).

Moving from public seed subsidies to vouchers could help crowd in the commercial sector. Carter *et al.* (2013) find that discount vouchers for improved varieties and fertilizers increased their adoption in Mozambique, but many farmers did not use their voucher. This suggests that cost is not the only constraint preventing farmers from adopting improved varieties. In Nigeria, vouchers for certified seed of improved rice varieties—provided to randomly selected farmers—had a positive and statistically significant impact on annual household income and per capita consumption expenditure, with larger impacts in absolute terms for male-headed households than female-headed households (Amoke Awotide *et al.*, 2013). Gender differences in access to resources such as land, credit and inputs could explain why women benefitted less from the intervention than men, and more detailed data could have helped identify which aspects lowered program benefits among female-headed households.

Table 1 – Studies on public sector innovations for enhanced seed systems outcomes

Citation	Analysis of seed systems outcomes				Analyzes differences in gender outcomes			Tests innovation	Discusses sustainability
	Availability	Quality	Access	Use and control	Reach	Benefit	Empowerment		
Providing information									
Ragasa et al., 2013			√	√	√				
Gilbert et al., 2002		√	√	√	√				
Theriault et al., 2017			√	√	√				
Nahayo et al., 2017			√	√	√				
Mishra et al., 2020			√	√	√	√			
Mudege et al., 2016	√	√	√	√	√	√	√		
Ragasa and Mazunda, 2018			√	√					
Kondylis et al., 2017			√	√				√	
Pan et al., 2018	√	√	√	√				√	
Beaman et al., 2015			√						
Clarkson et al., 2019			√	√	√	√		√	
Van Campenhout et al., 2020			√	√				√	√
Bergman Lodin et al., 2012	√	√	√	√	√	√	√		
Teklewold et al., 2013			√	√	√	√	√		
Teklewold, 2020	√	√	√		√	√	√		
Njuguna et al., 2016	√	√			√	√	√		
Oumer et al., 2014	√	√	√	√	√	√	√	√	√
Mudege et al., 2015	√	√	√	√	√	√	√		
Lecoutere et al., 2019			√	√	√	√	√	√	
Providing inputs/subsidies									
Abate et al. (2018)	√	√	√	√	√	√		√	√
Pan et al., 2018	√	√	√	√				√	
Mason and Smale, 2013			√	√	√	√		√	√
Fisher and Kandiwa, 2015			√		√			√	
Mason and Ricker-Gilbert, 2013			√	√	√	√		√	√
Carter et al. (2013)			√	√				√	
Amoke Awotide et al., 2013	√	√	√	√	√	√		√	
Ambler et al. (2020)			√	√				√	
Ambler et al. (2018a)			√	√				√	
Quality assurance									
Gilligan and Karachiwalla (2019)		√	√	√				√	
Reinker and Gralla (2018)		√							

The advantage of cash over vouchers is that recipients can allocate investments based on what they believe is optimal to enhance their productivity, profitability, farm income or family wellbeing. A large body of literature on social protection shows that cash transfers can have large impacts on household wellbeing and that households do not ‘waste’ these transfers on temptation goods such as alcohol or tobacco, suggesting that they should perhaps be utilized in the seed delivery space (Devereux, S., 2016). Recent experiments by Ambler *et al.* in Senegal (2020) and Malawi (2018a) combine extension services with ‘lumpy’ cash transfers for smallholder farmers. They find that when combined, these programs have stronger impacts on investments in seeds and other inputs in agricultural production than when offering only cash or extension. These findings point to complementarities between relaxing cash and information constraints.

In sum, many programs that involved resource transfers generated promising results in terms of enhancing agricultural productivity, and sometimes even household consumption. At the same time, none of these studies find that the provision of seed subsidies, vouchers, or cash grants helped reduce gender gaps in seed security, technology adoption, agricultural productivity or household consumption. Studies analyzing these programs either did not document gender-disaggregated impacts, or, if studying impact heterogeneity, did not find relatively larger benefits among female-headed households. Moreover, not a single study reported measuring empowerment indicators. Collecting data on different dimensions of empowerment among both men and women could have helped explore why women benefited less from these resource transfers, and how programming could have been adapted to address the specific constraints that women face when utilizing the resources, in order to become more gender-responsive.⁶

Seed quality assurance

It is widely acknowledged that it is difficult for farmers to determine the quality of seeds prior to purchase, and that it is also challenging to attribute crop failure to poor-quality seeds, given the numerous factors determining crop growth, including weather, soil health, and management practices. The concept that poor-quality products and information asymmetries can create a

⁶ A final question concerns the sustainability of these innovations, with few studies discussing the cost effectiveness and potential sustainability of the programs that were analyzed. One area of concern in this regard is the high cost of transactions and transportation from the input distribution center to the farmer in rural areas of sub-Saharan Africa (Minten *et al.*, 2013). A partial reallocation of government expenditures from subsidies to infrastructure to reduce such transaction and transportation costs could provide higher returns to agricultural growth and poverty reduction (Jayne and Rashid, 2013), and should be a major consideration in making seed systems more inclusive.

“*market for lemons*”—whereby farmers are unable to discern the quality of the seeds they are buying—has been examined for several inputs, including seeds. Bold *et al.* (2017), for instance, test fertilizers and hybrid maize seeds purchased in local markets in Uganda. They find that 30% of nutrient is missing in fertilizer, and hybrid maize seed is estimated to contain less than 50% authentic seeds, substantially lowering average returns. Ashour *et al.* (2019) find that the average bottle of herbicide is missing 15% of the active ingredient and that farmers’ beliefs in products being counterfeit or adulterated are significantly correlated with actual quality at the local market level, which could explain, to some extent, misuse or overapplication of herbicides.

Barriga and Fiala (2020), on the other hand, claim that seed quality does not deteriorate down the supply chain, suggesting that it is less about poor quality, and that the principal issue is predominantly how seeds are stored or mishandled. Consistent with this hypothesis, in Tanzania, despite fertilizers meeting nutrient standards, farmers believe that products are adulterated, due to observable deterioration which is attributed incorrectly to unobservable nutrient quality, potentially explains low fertilizer adoption (Michelson *et al.*, 2018). This indicates that regardless of whether quality control is the key issue, and not a lack of observability, enhancing farmers’ trust in input quality by assuring them that the products are authentic could have large impacts on the perceived quality and thus willingness to adopt these seeds. We therefore also reviewed a set of studies that help improve our understanding of how quality assurance could contribute to seed systems outcomes.

Gilligan and Karachiwalla (2019) evaluate an electronic verification scheme in Uganda whereby inputs were labeled with unique scratch codes which farmers could enter on their mobile phones to verify authenticity prior to purchase. Farmers in randomly selected villages were trained on this quality assurance system. The authors find that the scheme increased adoption of hybrid maize seed by 51 percent, with farmers informed of the scheme indeed believing that labeled agricultural inputs were of higher quality. Further, some evidence was found that product assurance schemes improved the average *quality* of hybrid maize seed, and specifically for tagged seed. Due to the nature of the experimental design, in which the main treatment is the provision of information on the quality assurance system, this study does not address the question whether impacts were driven by an increased awareness of the scheme and how it operates, or by the quality assurance itself.

Reinker and Gralla (2018) argue that bundling quality verification with an education-oriented intervention is more powerful than just verification alone. Simulating agricultural input markets through experimental games with input retailers and smallholder farmers in Bangladesh, De Brauw and Kramer (2019) show that farmer understanding may indeed be an important factor in the effectiveness of quality accreditation schemes. Thus, quality assurance alone may not account for the findings observed in Gilligan and Karachiwalla (2019), but rather, the findings may be driven by a combination of quality assurance and training on how quality assurance works.

Overall, a gender lens is missing from this research area. Quality assurance schemes targeting the formal sector would not directly reach and benefit farmers who rely more on the informal seed system. More gender-responsive interventions would extend policies around quality assurance to the informal sector, for instance through ‘quality declared seeds’, or focus on increasing the reach and awareness of quality assurance. An important question is also which varieties are included in quality assurance schemes, and if these varieties reflect the diversity of preferences and needs of female and male smallholder farmers. Moreover, with technology- or mobile-based solutions such as e-verification, quality assurance could also exacerbate the effects of a digital divide, with women having less access to mobile phones, or lower phone literacy. At the same time, improved methods to verify the authenticity of seeds could also lead to decentralization in the marketing of quality seeds and increase entrepreneurial opportunities for women to start trading seeds in their communities.

3.2 Civil society and private sector interventions to improve seed systems

The 17 sources reviewed under this category focused on approaches that attempted to support private seed enterprises, predominantly with a ‘bottom of the pyramid’ approach. In general, programs that we reviewed targeted local seed businesses and community seed banks. We documented fewer innovations with commercial seed companies, or programs that take a holistic approach to seed systems development. Finally, we reviewed innovations in financial instruments to support farmers in their seed purchases and use.

Informal seed systems and farmer-led seed delivery

A first set of innovations focused on strengthening farmer-led seed delivery. Mucioki *et al.* (2016) show that despite the existence of a formal seed sector in Kenya, these distribution networks do not reach smallholder farmers, and the formal sector's primary focus on maize reduces value for farmers whose livelihoods rely on other crops. Most farmers obtain improved varieties through seed aid, or by recycling seeds of varieties received as seed aid in previous seasons. Thus, through recycling of seeds, the improved genetics do make their way into the informal seed system. The same holds for the case of wheat in Ethiopia, where informal networks are an important source of modern varieties, even among farmers who initially sourced wheat seed from the formal sector (Bishaw *et al.*, 2010). By facilitating learning and access to neighbors' planting material, social networks also played a crucial role in the adoption of iron-biofortified beans in Rwanda, which were developed while considering women's preferences; with potentially longer-lasting benefits for women, who were less likely to dis-adopt the beans than men (Vaiknoras *et al.*, 2019).

Women are also thought to be more likely to access seeds through the informal seed system than men, meaning that the diffusion and recognition of improved genetic materials in the informal seed system is important to advance gender outcomes. Thus, disseminating improved varieties in a broader geographical area, whilst leveraging social networks to diffuse the genetic materials, appears a more cost-effective and inclusive strategy than concentrating efforts on smaller areas to promote seeds through the formal sector (Vaiknoras *et al.*, 2019). In many countries, this will require formal seed policies to adapt and recognize the importance of the informal seed system, and to strengthen both sectors.

A challenge when leveraging informal networks with mixed gender compositions to promote seeds could however be that due to existing gender norms, some farmers might discriminate against female messengers (BenYishay *et al.*, 2020). A field experiment in Malawi assigned either men or women the task of a communicator, who would learn about a new agricultural technology and then convince others to adopt. Male and female communicators had equal abilities to acquire, retain and use the information. Farmers were however less willing to learn from female than male communicators, as they perceived women not to be as good at farming as their male counterparts. Despite these challenges, female communicators attained equal rates of technology diffusion, and their farmers learned just as much about the technology, with similar gains in farm yields, as male

communicators. More such experiments are needed to understand how gender norms influence learning, access, adoption, use and control in the promotion of seeds within informal farmer networks.

To strengthen farmer-led seed delivery, one case study looked at efforts in Ethiopia to organize farmers into Local Seed Businesses (LSBs) to produce and market quality seed with variety choice informed by local preferences—targeting markets that are either not attractive for private companies or cost effective for public enterprises (FAO and ISCRISAT, 2015). A consortium of five universities and one public seed enterprise organized 200 LSBs, producing quality seed of 22 crops and 85 varieties. These LSBs contributed to local food security, but impediments to this approach also surfaced, including the inaccessibility of traditional vegetable germplasm, lack of technical know-how, institutional bottlenecks, lack of strong collaborative links between seed sector stakeholders, and an unsupportive policy environment. More research, however, is needed to identify the potential for LSBs to reduce gender inequalities. Violon *et al.* (2016) and Winniefridah and Manuku (2013) suggest that informal networks could offer a path to gender inclusiveness, but do not test the hypothesis.

An alternative strategy to strengthen informal seed systems is to promote community seed banks. Vernoooy *et al.* (2015) describe South Africa’s community seed-bank strategy through qualitative interviews with two all-women run pilot projects. Those interviewed anticipate positive results such as a range of different crop species and varieties inherited from their parents, extra cash, and the amelioration of a loss of crop diversity. Testing whether the women-led community seed banks indeed helped realize those anticipated results and if so, how and for whom, is also an important area for future research.

Connecting with commercial seed companies

One concern in seed delivery is that the formal seed sector is essentially an overly long chain from seed producer to distributors, wholesalers, retailers, and eventually the farmer. Along this path, quality can be diluted, and each actor charges their own mark-up, increasing the price of seeds. To solve this “middle-man” problem, the *One Acre Fund*, an NGO, has set up its own procurement system for fertilizer and seeds, shipping 500 metric tons of seed and 6,000 metric tons of fertilizer

to Kenya each year for distribution among 80,000 farmers.⁷ The experiment is repeated with regards to seeds—with the NGO negotiating with African-based seed companies for the best price on a number of crops; then, redistributing down to farmers. Although we did not find peer-reviewed research on the sustainability and inclusiveness of this approach, early results show promising impacts (Deutschmann *et al.*, 2019).

Importing seeds from international markets presents a short-run leverage of economies of scale from bulk buying but does not necessarily promote local seed production and develop a strong local seed sector; for crops and seed value chains where developing local seed businesses could be viable and sustainable, bulk procurement of seeds abroad could even crowd out the local seed system, unless procurement is done from African-based seed companies. This calls for a more integrated approach. To strengthen local seed sectors, the *Seeds Systems Group*, is working with—and oftentimes even helping establish—local seed companies and strengthening seed systems across 15 countries in Africa through a broad range of activities to bring improved seed technologies through local commercial seed companies to smallholder farmers. The aim is to improve access to high-quality varieties, with the target of reaching approximately 38 million farmers in countries where there is virtually no access to improved crop varieties.⁸

Njuguna-Mungai (2017) and Adam *et al.* (2019) apply a gender lens when discussing ways to connect communities with commercial seed companies, creating a nascent template for what a training manual could include for seed companies to increase gender responsiveness. In Tanzania, Njuguna-Mungai (2017) looked at gender ‘gaps’ and norms that prohibit access to seeds and suggest an agenda for private seed companies to i) employ more female agents to sell to women and employ more women generally in their companies; ii) set aside a ‘corporate social responsibility’ budget to pay for childcare services for female employees; and (iii) set up out-grower schemes through which female farmers are contracted to produce seeds. The outcome from such recommendations need to be tested.

⁷ For more information on seed and fertilizer procurement, see <https://oneacrefund.org/blog/behind-the-scenes-seed-fertilizer-procurement/>.

⁸ <https://seedssystemsgroup.org> Focus countries include Angola, Benin, Burundi, Cameroon, Chad, Cote d’Ivoire, the Democratic Republic of Congo, Eritrea, Guinea, Madagascar, Republic of Congo, Senegal, Sierra Leone, and Togo.

Kandiwa *et al.* (2018) provide a number of recommendations through which seed companies could inform both women and men about improved varieties. These include establishing gender balance in the recruitment of extension officers; recruiting women or households instead of solely men for demo plots; placing these plots in locations where they are visible also to women (who due to gender norms often have less mobility than men); organizing farmer field days in locations and at times where both men and women can participate; engaging with men and boys on how important it is to involve their spouses and mothers in information sharing and decision-making; collecting gender-disaggregated monitoring data; and, ensuring that other promotional materials such as radio messages or marketing apparel are appropriate for both men and women. These more inclusive marketing approaches would however only be adopted by commercial seed companies if such approaches were shown to be cost effective from a seed company point of view. Hence, more testing is needed of whether gender-responsive marketing generates a sufficient and sustained increase in demand for quality seeds to enhance seed companies' profitability.

Holistic seed systems approaches and integrated seed sector development

One innovation of note is the Wider Action Program (WAP), a localized model which aimed to disrupt the bean seed delivery system across 18 African countries that had previously relied predominantly on agricultural extension (Rubyogo *et al.*, 2010). The WAP sought to completely redefine the division of labor within the seed supply chain—a holistic approach that included *all* key actors in seed systems. Traditionally, NARs would develop the new varieties, and then produce an initial supply of breeder and foundation seed. Government seed parastatals and commercial seed companies would take over production of certified seed to sell directly to select distributors, mainly extension services and NGOs. They, in turn, would deliver subsidized seeds to farmers through development programs.

In contrast, the WAP held meetings in each country with key actors in the seed system, including NGOs, Community Based Organizations, farmer groups and church groups. This created a clear vision on the comparative advantage of each actor, increasing the visibility of smaller groups by larger actors in the seed market, and increased understanding of the contacts that local organizations have with farmers across wide geographical areas, as well as their experience in local-level organization and facilitation. International NGOs also reported their extensive

geographical reach, including in marginal, resource-poor areas. Researchers maintained their position as subject experts of improved varieties, pre- and post- harvest management, disease identification and control, and agro-enterprise development. Traders came with market intelligence.

As a result of these meetings, the production of breeder and foundation seed remained a NARS responsibility, and seed parastatals and seed companies took the lead in supplying commercial seeds of the widely adapted popular varieties, but decentralized production in target zones became the chief activity of locally based producers, often supported by organizations such as public extension, NGOs, or FOs. Assessments show that as a result of this approach, in six countries, 3.8 million households were reached with new varieties from 2003 to 2005. This study, however, did not provide insights on the benefits or empowering impacts of this approach for female versus male farmers, nor on whether the approach was sustained over time. As many studies focusing on innovations in seed systems delivery, this study stopped at the ‘reach’ level, again highlighting an important evidence gap.

Financial inclusion

The World Bank’s Findex Global Database reveals that when suffering an adverse agricultural shock, most farmers invariably bear the entire financial burden themselves, lacking any financial tools to manage risks (Klapper *et al.*, 2019).⁹ Access to financial instruments to save, borrow and manage risk can however be crucial in the market for seeds. A number of innovations have started to focus on testing commercial business models to sustainably promote the adoption of improved varieties using alternative financial instruments including savings, credit, insurance and mobile money.

An ongoing experiment in Mali and Senegal called myAgro (Ratnayake, 2016) offers a solution whereby farmers can make incremental payments towards the future receipt of agricultural inputs like seed and fertilizer through a mobile savings technology that mirrors the purchase of prepaid cellphone credit. The program delivers physical scratch cards to its network of third-party vendors. Farmers enroll and choose a desired package of inputs. They scratch their card to reveal a secret

⁹ Based a representative survey of around 15,000 adults in Sub-Saharan Africa from FINDEX data (IBID).

code and use their mobile phone to send that code via SMS to myAgro, which verifies the transaction and credits the value to the farmer's balance. Once farmers reach their financial goals, myAgro delivers the package of inputs to a nearby distribution center. The close resemblance with topping up cellphone credit and the tangibility of a physical card, minimize the perceived risk of trying a financial service with a digital element for the first time. At first glance, this approach appears promising, but to our best knowledge, there is no rigorous research on the sustainability or inclusiveness of this model.

Karlan *et al.* (2016) compare the effects of cash grants versus index insurance for drought. Although farmers reported a lack of credit as the main constraint to invest in agriculture, providing them with drought insurance—reducing risk—had a significantly stronger effect on investments than cash grants—which relax credit constraints. This suggests that farmers were rationing investments because they anticipated a possible drought destroying their crops, and that the use of quality seed could be enhanced by providing adequate financial instruments that reduce this uninsured risk. With that in mind, a team of researchers from the University of California Davis and the International Maize and Wheat Improvement Center (CIMMYT) tested the bundling of improved drought-tolerant varieties with weather index insurance, which would provide new seeds to farmers experiencing drought-related crop failure. By means of a randomized controlled trial, the study team finds that after experiencing a severe drought, the insurance-seed bundles increased farmers' investments in drought-tolerant maize varieties, enhancing productivity relative to farmers who did not have insurance, for whom widespread crop failure resulted in capital losses (Feed the Future Innovation Lab for Markets, Risk and Resilience, 2019).

Delavallade and Godlonton (2020) evaluate the potential for combining credit with storage through warrantage, a localized inventory credit scheme to overcome credit and mid-term storage constraints. Their randomized controlled trial in Burkina Faso finds that nearly all households store their crops with the local storage facilities, but only 38 percent of households use their crops to take out loans. Households with access to this innovative model for rural finance are able to store their crops beyond the harvest, waiting until prices are higher. As a result, these households sell on average at higher prices, with increased income then spent on long-term investments, including education, livestock purchases, and agricultural inputs for the subsequent year. Most households in this study are male-headed, and although polygyny is common, there is no focus on intra-

household dynamics in the decision to store crops, take out loans or how to reinvest increased incomes.

The current literature on financial inclusion for seed systems entirely lacks a gender lens. Much can be done, however, to better reach, benefit and empower women through innovations in financial services. Several studies outside of the seed systems domain (and thus not listed in the tables below) find empowering impacts of various financial services. Financial inclusion can provide opportunities for greater financial autonomy to influence household bargaining (Doss, 2013; Amin *et al.*, 1998; Goetz and Gupta, 1996; Kabeer, 2001b). An experiment in Uganda for female microfinance borrowers, for instance, shows that bundling a microfinance loan with a mobile money account (to ensure financial autonomy) enhances business performance (Riley, 2020). Future research could test how bundling seeds with alternative financial instruments could enhance women's financial autonomy and empowerment in the use of and control over seeds.

Overview

In sum, only 9 of 17 reviewed studies tested innovations whereby the private sector can promote the use of quality seeds, with other studies adopting a descriptive approach. While these provide important insights into how informal seed networks currently work, they do not experiment with approaches to leverage informal networks to enhance seed security. Moreover, relative to the public sector literature, many studies do not analyze gender inclusivity, with only 3 of the 9 studies on innovations analyzing gender gaps in reach, and only 1 study considering gender norms underlying women's empowerment in how social networks can be leveraged for the diffusion of new technologies. Finally, despite these innovations being driven by the private sector, it is perhaps surprising that none of the reviewed studies included a cost-benefit analysis, with a discussion of sustainability and the potential for scaling. This indicates that this area of research, still in an early stage, has much fertile ground for future research.

Interestingly, although many practitioners see increased commercialization of farming as a key trend (Setimela *et al.* 2020), innovations to ensure the inclusion of a diverse range of smallholder farmers have yet to be fully tested and proven. More testing is needed to ascertain the sustainability and inclusiveness of models such as farmer-led seed delivery or efforts to connect farmers with seed companies. The most ambitious interventions driven by international NGOs adopt a more

holistic approach and seek to disrupt the seed value chain and insert themselves as new players that aim to leverage economies of scale and act as a broker between seed companies and underserved smallholder farmers. Such interventions have generated promising findings, but the knowledge base is at an early stage. Innovations in the design of financial services to increase demand for quality seeds lack a gender lens, and could therefore benefit from existing approaches to increase women's financial autonomy per se.

Table 3 – Studies on civil society and private sector innovations for enhanced seed systems outcomes

Citation	Analysis of seed systems outcomes				Analyzes differences in gender outcomes			Tests innovation	Discusses sustainability
	Availability	Quality	Access	Use and control	Reach	Benefit	Empowerment		
Informal seed systems and farmer-led seed delivery									
Mucioki et al., 2016	√	√	√						
Bishaw et al., 2010	√	√	√	√					
Vaiknoras et al., 2019	√	√	√	√	√	√		√	
BenYishay et al., 2020			√	√	√	√	√	√	
FAO and ISCRISAT, 2015	√	√	√	√				√	
Violon et al., 2016				√	√				
Winniefridah and Manuku, 2013	√	√	√	√	√	√	√		
Vernooy et al. (2015)	√	√	√	√	√	√	√		
Connecting with commercial seed companies									
Deutschmann et al., 2019	√	√	√	√				√	
Njuguna-Mungai. 2017	√	√	√	√	√	√	√		
Adam et al., 2019	√	√	√	√	√	√	√		
Kandiwa et al., 2018			√	√	√	√	√		
Holistic seed systems development									
Rubyogo et al., 2010	√	√	√	√	√			√	
Financial inclusion									
Ratnayake, 2016			√					√	
Karlan et al., 2016			√	√				√	
Feed the Future Innovation lab for Markets, Risk and Resilience, 2019			√	√				√	
Delavallade and Godlonton, 2020				√				√	

Promising ideas for future innovations in local seed delivery systems could focus on i) production interventions such as collective demand forecasting; aggregated production planning; advanced booking/purchase of fortified seeds; and the aggregation of farmers into contiguous units, building on the model that is being tested by the One Acre Fund; and, ii) innovative marketing approaches such as mobile seed-sale vans; community sales representatives; packaging in buckets or easy to carry bag/small packs; innovative use of technologies to communicate and provide technical advice; bundling with financial services; and, a crucial aspect albeit not discussed in the literature, technical support for seed companies to access credit, manage debt and develop smart apps to report sales and stock data for just-in-time seed supplies.

3.3 Broader livelihood approaches

Reflecting on the studies reviewed, there is a danger that innovations in seed delivery systems will focus on the simplistic goal of enhancing inclusivity by simply expanding the ‘reach’ of seed systems programs and policies. As this review argues, reach is simply not enough, and only a broader livelihood approach for female farmers—understanding their power over money and resources—will move the dial on empowerment. A focus on innovations that help enhance the productivity or profitability of “women’s crops” does not suffice in this regard. Doss (2002) cautions against the assumption by both governments and donors that some crops are rigidly defined along strict gender norms by households and farming communities as “women’s crops” and “men’s crops”—despite what farmers themselves actually claim. Orr *et al.* (2014) argue that in Zambia, the commercialization of crops such as groundnut, sorghum, or millet—traditionally grown for food security and nutrition—may in fact have a negative impact on gender equity if men take control of decisions and roles that were previously controlled by women. This highlights the importance of gender analysis for value chain development.

Ali *et al.* (2015) assess the extent to which seed delivery systems matter in terms of women’s agricultural productivity in Sub-Saharan Africa. Using national data from the Uganda National Panel Survey a productivity gap before controlling for endowments was estimated to be 17.5 percent—with women less productive than men. It was found that although men have greater access to inputs, input use is so low and inverse returns to plot size so strong that smaller female-managed plots have a net endowment advantage, improving their productivity relative to men, *ceteris paribus*, by 12 percent. This means that controlling for endowments increases the

unexplained productivity gap to 29.5 percent. In other words, for every acre cultivated, women produce close to one third less than men. Two-fifths of this unexplained gap is attributed to differential returns to the child dependency ratio, and one-fifth to differential returns to transport access. Smaller and less robust drivers include differential uptake of cash crops, and differential uptake and return to quality seeds and pesticides, meaning that innovations in seed systems delivery would not necessarily make great strides towards improving gender equality in productivity.

Other literature suggests that farming (whether by improved seed systems or other interventions) may not always be the first-best approach to empowerment. Christiaensen and Demery (2018) argue that the policy priority for women in agriculture is not so clear-cut given the lower than expected female labor shares—well below 50% in most countries in Sub-Saharan Africa. Quisumbing et al. (2019) suggest that while increasing productivity on the plots that women manage is important, it should not be the only goal. Since many female farmers are poor and live in marginalized areas, agricultural interventions should be designed to reduce poverty and to increase not only the value of output per unit of land but also the value of output per unit of labor. This may mean that farmers could become engaged in off-farm activities with higher returns, especially in areas with poor-quality land. At the same time, whilst a framed experiment in Ghana finds higher demand among women than men for engagement in such activities, this gender gap was smaller than expected, with both men and women revealing a strong preference for diversified investments (Kramer and Lambrecht, 2019).¹⁰

Section 4. Discussion and Conclusion

In general, we find a few innovative approaches across both categories of seed delivery systems, with agricultural extension more likely to address the full range of outcomes (availability, quality, access, use and control). But in general, there is a concerning lack of gender lens approaches for both types of interventions; this despite the decades of research on ineffective male-centric development approaches. Drucza *et al.* (2018) hypothesize that gendered project design must be evidence based and discussed with wider project staff; advocating for rapid assessment approaches

¹⁰ Differences between men and women were largely explained by gender stereotyping around perceived skills, suggesting that efforts to reduce gender inequality should address gender stereotypes and beliefs that prevent women from investing in agriculture.

that will allow project designers to quickly assess women's roles within the household, constraining gender norms, and women's constraints in agricultural markets. Roo (2016) maintains that it is important for seed sector projects to make a *conscious* and *explicit* choice to target women, and that such efforts require additional resources. Pouw *et al.* (2019) caution that some innovations utilizing information technology and communications interventions could create new inequalities due to the existing lack of ICT literacy and access among women. It is important to monitor such developments to make sure that interventions do no harm and analyze ways to mitigate these new inequalities in the absence of intra-household power dynamics it's rare to see an intervention that truly reaches "empowerment" status.

Several key themes emerged from the literature review, which are summarized below and in more detail in subsections that follow:

- **Get Testing!** While many studies focus on gaps and provide suggestions on how to address gender gaps in access, quality, availability, as well as the use and control of seeds, much research has been conducted to simply analyze the functioning (or failures) of existing seed delivery mechanisms. Few actually test innovations to help diminish that gap. In fact, even the evidence on the sustainability of alternative business models for seed delivery is limited, providing ample scope for testing different types of innovations.
- **Extension still looms large:** Government extension programs (agricultural inputs, technical assistance) are largely failing women farmers; and it is widely understood that this is due to a lack of consideration for a priori gender imbalances both within the household and in terms of basic assets such as land and finance. A few studies found promising effects of vouchers, bundled services, and a focus on how extension information is delivered given receptiveness to new information. Yet, the examples of innovative experimentation to fix these gender gaps are few and far between.
- **Bottom of the Pyramid results uncertain:** Papers that examine the space between public and private seed delivery models, including farmer-led seed delivery and community seeds banks, show mixed results. Some authors show that for some crops in certain geographical areas, these types of mechanisms can improve agricultural productivity. Other authors question the

sustainability and reach of such approaches as well as cost impediments for subsistence farmers. Few experiments exist to show how these approaches could empower women—although some projects point to the use of informal networks combined with extension and innovations in marketing, using for instance vouchers and seed fairs.

- **A holistic approach to seed interventions:** We find promising results from innovations that take a holistic approach, addressing all the stages outlined in the diagnostic framework for seed systems. This also validates the use of such an analytical tool, and planning tool for innovative and sustainable interventions. Applying a gender lens in such programs, and quantifying the cost-effectiveness of these approaches with potential adaptations to enhance gender-responsiveness are an important area for future research.
- **What is empowering?** The number of peer review articles that completely lack a gender lens in this day and age is somewhat shocking; this can only lead to a partial understanding of seed delivery systems, and sub-optimal innovation in this sector. Gender analysis of seed delivery in general points towards the need for a broader livelihoods approach, to avoid interventions that might inadvertently lumber women with *more* work, which would harm empowerment, or perhaps trap them in unproductive agricultural pursuits when off-farm activities would be more beneficial.

It became evident that *successful, sustainable and gender inclusive* efforts to improve seed delivery systems are few and far between. Nevertheless, attempts to “increase the pie” through improvements to either government or private sector systems are unlikely to cease. As such, it is important to consider the relationship these efforts should have with gender empowerment. The research shows that without gender equality in financial autonomy, there is a clear danger that efforts could fail to empower women and in fact, leave them with a higher burden of work, or shift resources, power and control to male household members. There are many ways to promote women’s financial autonomy, either through financial instruments, gender norms interventions, or by promoting local businesses and entrepreneurship, with women-led businesses for seed production and seed trading offering a promising gender-transformative strategy (Galié et al., 2020).

Given the importance of women's agency and autonomy in decision-making, this also requires monitoring plans to collect gender-disaggregated mixed methods data not only on reach but also on the benefits and empowering effects from innovations in seed delivery models. Intra-household dynamics are crucial, especially since the majority of women live in male-headed households. Research needs to take a more experimental and innovative approach, moving beyond diagnostics and discussions of "what is currently wrong and how could things be improved in theory" to testing inclusive models for seed delivery. Seed systems research is in dire need of more examples that demonstrate what could go right, providing evidence on mechanisms through which innovations impact the sustainability or inclusivity of seed delivery. The tools to better understand gender in the seed sector are there; the time is ripe for a new phase of more action-oriented seed systems research in which practitioners and researchers empirically test which innovative business models reach, benefit and empower women and men alike.

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