GENDER EQUALITY TOOLBOX

GENDER, AGRICULTURE AND CLIMATE CHANGE BRIEF

Prepared for the Agricultural Development Program Strategy Team and Gender Equality Team of the Bill & Melinda Gates Foundation by the Global Center for Gender Equality at Stanford University

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1. INTRODUCTION

Climate change is a global threat to sustainable development and food security. In developing countries, dependence on rain-fed agriculture and natural resources as a principal livelihood strategy is leaving millions of smallholders, many of them women, especially vulnerable. For farmers, climate change has the potential to increase the frequency and intensity of weather extremes, including droughts and floods, along with attacks from crop and livestock pests and diseases. There is also concern that previously reliable rainfall patterns could abruptly shift from year to year, making it difficult for farmers to decide when to plant their crops.

Women farmers face additional challenges that could substantially amplify climate-related threats. They include a history of unequal access to land, labor, and capital, as well as a lack of agency in household decision-making. These longstanding inequalities could become a significant barrier to implementing strategies for adapting agricultural production to the stresses of climate change. Meanwhile, the increases in poverty and food security brought on by climate change could exacerbate existing gender-related social problems, including putting more women and girls at risk for early marriage, gender-based violence, and other forms of exploitation (Castañeda Camey et al. 2020).

Integrating a strong gender focus to agricultural adaptation initiatives has the potential to produce multiple benefits. Given the prominent role of women in agriculture in places like sub-Saharan Africa and South Asia, improving their resilience to climate shocks can contribute to boosting productivity across the agriculture sector. A more gender-intentional approach to adaptation also could contribute to the broader effort to improve gender equality in developing countries. Unfortunately, however, very little is known about what works to achieve these outcomes. New insights are needed as donors, countries and international institutions ramp up agricultural adaptation initiatives.

This brief is a targeted review of the evidence currently available on gender differences in climate change impacts on agriculture and gender barriers to the uptake of adaptation practices and technologies—a range of interventions often referred to collectively as Climate Smart Agriculture (CSA). It explores case studies examining efforts to integrate gender into CSA initiatives and offers broad recommendations for agriculture development programming, with a focus on research needed to fill the evidence gap. This brief does not address the gender dimensions of climate change adaptation policy outside of agriculture.

Methods:

Keyword searches of academic databases, queries to online search engines, and bibliographic back-referencing identified 91 potentially relevant documents, of which 37 studies met the broad inclusion criteria. Given the emerging state of the field, much of the published research and grey literature alike is exploratory and descriptive in nature. The majority of the work involves case studies based on small sample sizes from a single location. There are currently no multi-site studies with large sample sizes examining the intersection of gender, agriculture, and climate change. Caution must therefore be taken in generalizing the findings presented here.

There is a large evidence gap with respect to empirical research examining gender differences in agriculture-related climate impacts. This gap is even wider when it comes to research exploring gender differences in adopting CSA practices and technologies. It is unclear if this gap is due to lack of funding, uncompleted work that is still moving through the research pipeline, or methodological challenges to conducting rigorous research. In any case, the foundation is well positioned to strategically invest in developing a learning agenda on this vital topic.

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Key findings from this evidence review include:

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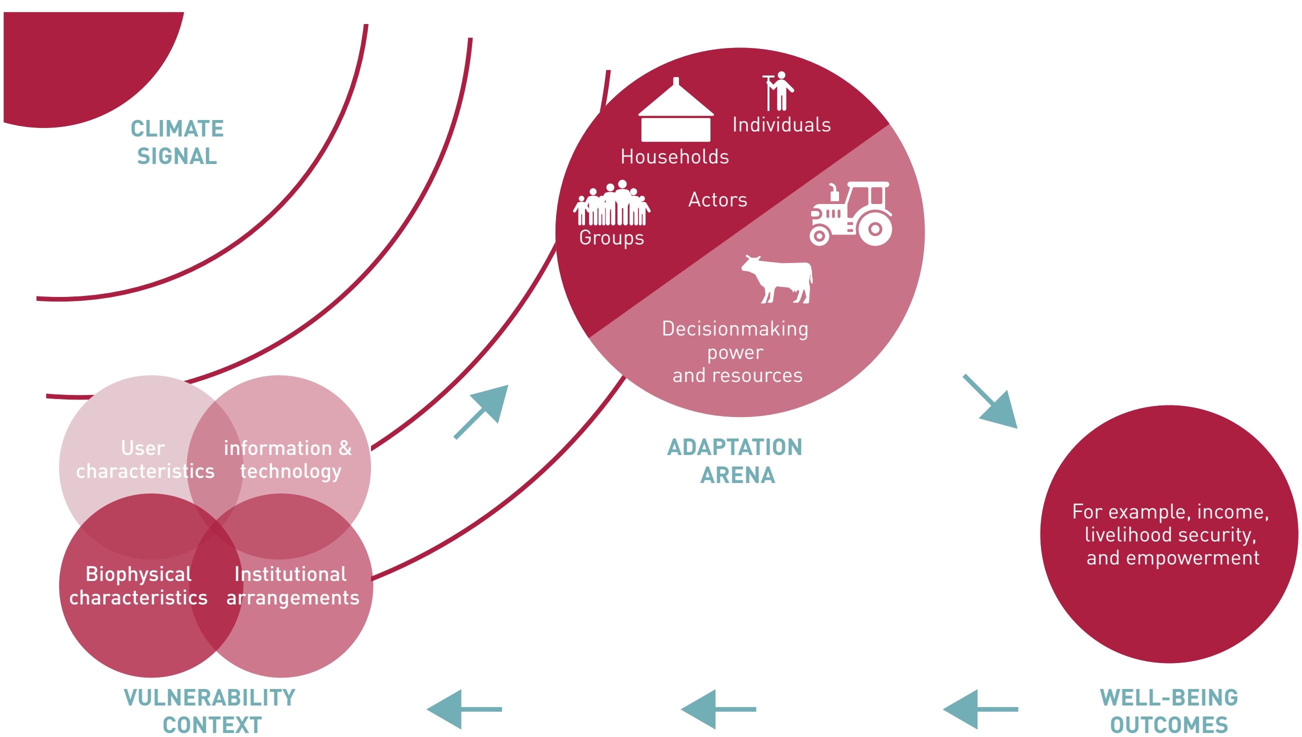
1. Gender differences in vulnerability to agriculture-related climate change impacts and adoption of CSA interventions are driven primarily by the following: the gender division of labor; the feminization of agriculture in large regions of the developing world; and longstanding gender disparities in access to and agency over key resources–chiefly land, labor, financial capital, and climate-relevant information.
2. Multiple international, national and local institutions are pursuing promising approaches to a gender-focused analysis and integration of climate change adaptation initiatives, with some of them showing a potential to contribute to women's empowerment .
3. There is significant opportunity for the foundation to help fill the evidence gap by investing in research that could produce strong empirical evidence on effective approaches to integrating a stronger gender focus to agricultural adaptation efforts.

2. WHAT DO WE KNOW ABOUT THE GENDER-DIFFERENTIATED IMPACTS OF CLIMATE CHANGE IN AGRICULTURE?

The International Food Policy Research Institute's research program on Climate Change, Collective Action, and Women's Assets has developed a useful analytical framework for examining the intersection of gender, agricultural development and climate change (Figure 1) (Behrman et al. 2014). The framework begins with examining the "climate signal"— long-term changes in average climate conditions and climate variability, such as the timing, intensity, and duration of precipitation and extreme weather events, like droughts and floods. This signal interacts with the "vulnerability context," which encompasses farmer characteristics such as livelihood activities, assets, social characteristics (including gender), and cognitive ability. The vulnerability context also includes biophysical characteristics (features of physical and ecological systems that define the natural limits of adaptation); information and technology; and institutional arrangements. The "adaptation arena" considers relevant actors – individuals, households and groups – and their decision-making power and resources. This a juncture where gender is likely to be particularly relevant. The ability to adapt then determines "well-being outcomes" such as income and food security, which in turn feed back into future vulnerability.

There is limited high-quality scientific evidence on the gender-specific impacts of climate change in agriculture. But two key factors are likely to drive the differences in how male and female farmers experience climate impacts. The first is the gender division of labor in agriculture, which has implications for the crops and livestock men and women raise and their farming activities. The second driver involves gender barriers to migration and employment options outside of agriculture. The result is the so-called "feminization of agriculture" now occurring in many parts of the developing world (particularly South Asia), a trend that makes women particularly vulnerable to climate change-induced declines in farm productivity.

Figure 1: An integrated framework on gender and climate change in agriculture



Source: Behrman et al. 2014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2.1 The Gender Division of Labor in Agriculture

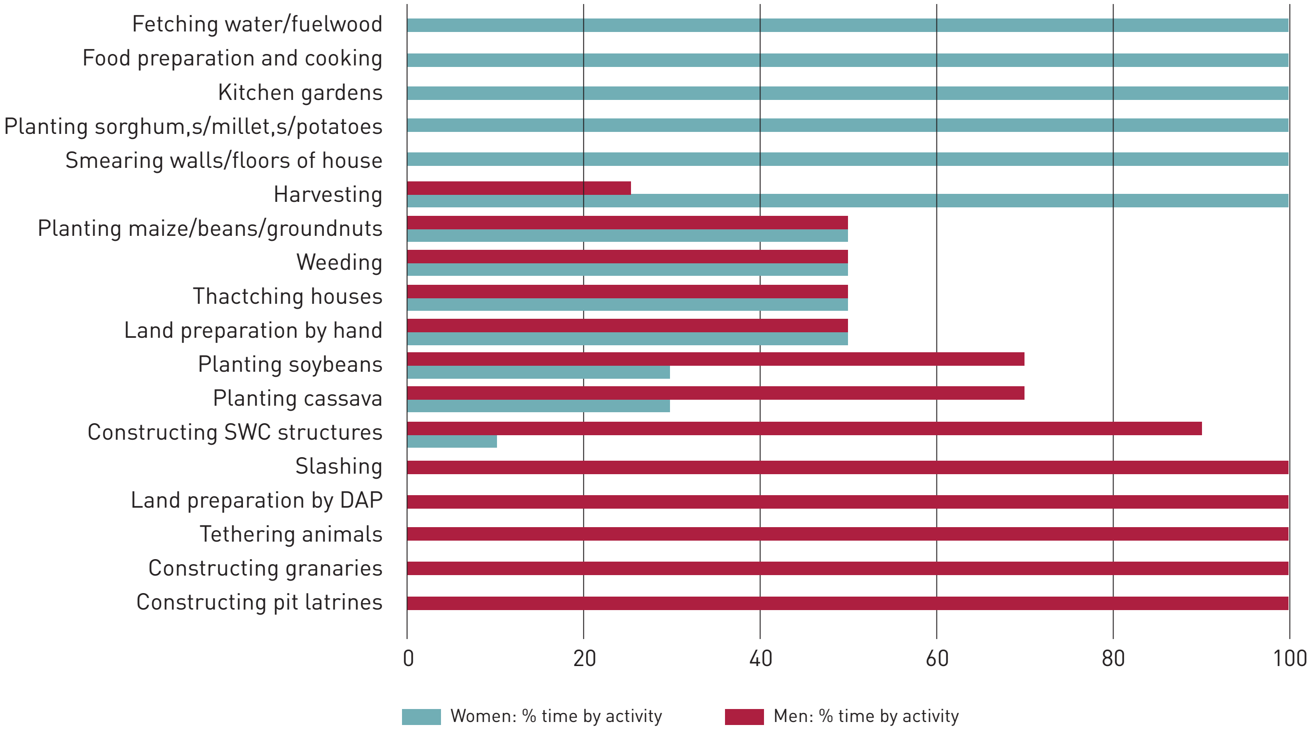
The gender division of labor in agriculture differentially exposes crops in which men and women specialize, the livestock they manage, and the livelihood options they pursue to negative climate change productivity impacts (Global Gender and Climate Alliance 2016). Traditionally, men have been more likely to manage cash crops, while women have more typically farmed subsistence crops for home consumption, including "kitchen gardens" of fruits, legumes and vegetables[1]. Men are also commonly responsible for chores such as land clearing, ploughing and harvesting, while women often work in seed selection and management, weeding, planting and postharvest processing. In many contexts, men have greater access to animals and mechanization for ploughing and clearing of land, while women's agricultural work tends to be more manual and labor-intensive.

Figure 2 illustrates sex-disaggregated time-use data among agricultural households in the Busia District of Kenya. It reveals a clear gender division of labor across crops, livestock and non-agricultural subsistence activities, each of which is differentially exposed to climate signals. Table 1 reports the comparative labor time (in days per hectare) across nine activities in three crops in two climate hotspots in Nepal. These are places where women have a significant role in transplanting, weeding and irrigating rice and harvesting and threshing of wheat and maize. Preparing land, sowing crops and applying fertilizers are mainly male activities (Khatri-Chhetri et al. 2019).

Time-use data from smallholders in central Malawi – where the frequency and intensity of climatological, hydrological, and meteorological shocks to rural families have been increasing since the 1990s – is revealing. It shows women specializing in food crop (primarily maize) production and post-harvest processing, in addition to caring for small livestock, collecting water and firewood, cooking, cleaning and childcare. Both men and women contribute labor to commercial crop production and processing (primarily tobacco), and men exclusively care for cattle and goats (Murray et al. 2016). Combining knowledge of gender specialization with information on crop-specific climate impacts[2] has the potential to more accurately estimate the different ways climate change effects men and women.

1. A recent systematic review of the impacts of environmental change on (non-staple) vegetables and legumes found that, in the absence of effective adaptation, predicted changes in environmental exposures would lead to reductions in global yields of non-staple vegetables and legumes. The mean (95% CI) reported yield changes for all vegetables and legumes combined were +22.0% (+11.6% to +32.5%) for a 250-ppm increase in CO2 concentration, –8.9% (–15.6% to –2.2%) for a 25% increase in O3 concentration, –34.7% (–44.6% to –24.9%) for a 50% reduction in water availability, and –2.3% (–3.7% to –0.9%) for a 25% increase in salinity (Scheelbeek et al. 2018).
2. For maize, see Mulungu and Ng'ombe (2019); for tobacco, see Chemura et al. (2013).

Figure 2: Gender division of labor in Nandafubwa, Busia District, Kenya



Source: Bishop-Sambrook (2003)
Note: SWC = soil and water conservation structures; DAP = Diammonium phosphate fertilizer.

Table 1 Men and women's participation in different agricultural activities (days/ha)

Activity	Paddy			Wheat			Maize		
	Male labor	Female labor	Mean t-test	Male labor	Female labor	Mean t-test	Male labor	Female labor	Mean t-test
Nursery preparation	5.57	2.95	7.02***	_	_	_	_	_	_
Land preparation	8.56	2.51	18.00***	7.42	2.14	8.91***	5.91	3.39	3.91***
Transplanting	0	22.95	19.91***	_	_	_	_	_	_
Seeding	_	_	_	4.58	1.23	9.43***	4.69	3.35	2.01*
Weeding	0.27	4.78	32.56***	1.00	1.21	1.9	11.71	16.07	3.01**
Irrigation application	0.73	3.10	9.44***	1.17	0.12	11.38***	0.37	0.19	1.3
Fertilizer application	18.25	6.08	17.80***	1.75	0.31	12.04***	1.23	0.47	4.11***
Pesticide application	12.44	12.85	0.54	0.5	0.01	3.98***	0.11	0.08	0.37
Harvesting + threshing	23.64	12.23	8.20***	25.01	29.10	3.36***	20.62	23.02	1.56*

Source: Khatri-Chhetri et al. (2019)

The gender division of labor is likewise manifest in commercial agriculture, with implications for gender differences in the climate change impacts on agricultural wage workers. Box 1 summarizes the findings from an empirical study of the predicted effects of temperature and rainfall variation on labor demand in the Sri Lankan tea plantation sector, which primarily employs Indian Tamil women (Gunathilaka et al. 2018).

Global livestock production is also characterized by a gender division of labor. Women are more likely to own and manage locally-adapted breeds and small animals such as sheep, goats and poultry, while men tend to specialize in larger and improved varieties of livestock, namely cattle. Within large livestock management there is also often a marked gender division of labor, where women, for example, are often responsible for supplying water to cattle (Chanamuto and Hall 2015). Because cattle are particularly vulnerable to the effects of climate change on grazing lands, men in cattle-raising areas may be disproportionately affected with respect to income and asset risk (McKune et al. 2015).

Identifying "hotspots" by combining female agricultural labor force participation with climate data is a promising method for revealing geographic areas where women farmers and agricultural workers may be especially vulnerable to climate change (Chanana-Nag and Aggarwal 2018). Examples utilizing this approach in India and Nepal are discussed in Box 2.

Box 1
Climate impacts on labor demand in Sri Lanka's tea sector

Perennial plantation crops – such as palm oil, rubber and tea – have contributed significantly to the economies of many developing nations. They account for a large percentage of the agricultural workforce in countries like Bangladesh, Kenya, Vietnam and Sri Lanka. Perennial plantations globally are far more vulnerable to climate change. There are limited opportunities for crop-switching in this sector and lengthy pre-harvesting periods. Yet climate impacts on perennial cropping are far less studied than annual crop effects.

Tea plantations are Sri Lanka's largest sector, employing seven percent of the total national workforce. Most of the laborers are lower-income Tamil women residing on the estates. They are typically their households' primary income earners. Employment on these estates is inherited from generation to generation. Workers are guaranteed a minimum amount of working days per month and strong trade unions regulate worker wages nationally. Estates also provide childcare, healthcare, schools and other welfare services for workers.

To look at future impacts of climate change on labor demand in the tea sector, researchers used a unique primary panel dataset from 35 tea estates in Sri Lanka spanning a twelve-year period between 2002-2014. They applied an estate profit maximization model to estimate labor demand elasticity with respect to different components of weather. They found that labor demand in the country's tea plantation sector is expected to decrease by over one million person-days per year by 2050 due to predicted changes in rainfall. This method also reveals differential impacts by region and monsoon season and highlights tea's particular vulnerability as a perennial crop.

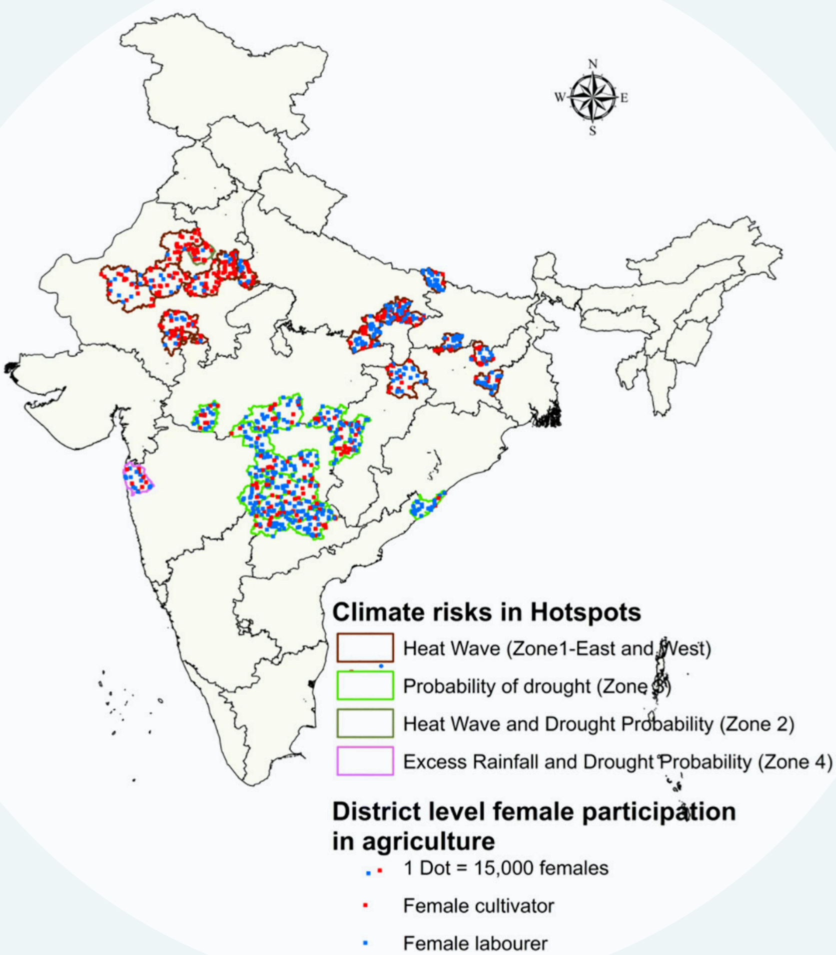
The critical role of tea estates to the livelihoods of Tamil women implies that this decrease in labor demand will have particularly negative consequences for these women, given their dependence on the plantations for income and social services and limited employment alternatives. There is an opportunity to replicate this study's approach to understand how climate change will affect labor demand in perennial cropping systems in other areas.

Source: Gunathilaka et al. (2018)

Box 2
Mapping hotspots to Identifying gender-specific vulnerability and adaptation responses

More targeted climate adaptation interventions could be developed by examining climatic risks experienced by women farmers, their social profile and the role they play in agriculture. Chanana-Nag and Aggarwal (2018) develop a simple methodology for identifying "hotspots" for prioritizing gender-based climate change adaptation interventions, one that is based on female participation in the agricultural labor force and local climatic risks. Using district-level census data from India, the researchers first calculated the absolute number of women whose major economic activity is working in agriculture as either a cultivator or a laborer. They then used gridded historical meteorological data to estimate the probabilities of drought, extreme rainfall and excess heat – climatic risks that have a substantial impact on the production of major crops. Agricultural labor force participation and climatic risk data were ranked on a scale ranging from "very low" to "very high." When combined they revealed 36 hotspot districts across ten states in the northern and central parts of the country (Figure 3). A similar exercise was conducted in Nepal, which also included poverty rates. It identified twenty-one district-level hotspots for prioritizing gender-inclusive Climate-Smart Agriculture interventions (Khatri-Chhetri et al. 2019).

Figure 3: Gender and Climate Risk Hotspots in India



Source: Chanana-Nag and Aggarwal (2018)

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2.2 The Feminization of Agriculture

The gender division of labor in agriculture, and the implications it has for climate change vulnerabilities, is not static. Climate change itself, along with economic development and the commercialization of agri-food systems, has induced significant transformations in the gender composition of the agricultural labor force in many developing countries. Specifically, it has increased the proportion of women in agricultural employment (Slavchevska et al. 2019).

This "feminization of agriculture," which is particularly notable in South Asia, is mainly due to male outmigration from rural areas, an exodus that may have been provoked by crop and income losses caused by climate change (Paudyal et al. 2019). In Nepal, for example, where male rural outmigration is significant, women's workload in agriculture has increased to over six times that of men. They have become the primary farmers while their husbands engage in urban wage labor (Gurung and Bisht 2014).

Agricultural commercialization – in particular the expansion of horticultural exports from Africa, Asia, and Latin America – has further contributed to women's employment in the sector. The majority of workers in these industries are female (van den Broeck and Maertens 2016).

The rising participation of women in both subsistence and commercial agriculture is leaving women in many regions more vulnerable to climate variability and shocks. From an adaptation standpoint, this means that women may end up shouldering more farm management and decision-making duties along with their increased labor contributions. However, it's not clear how often this will be the case. A qualitative comparative analysis of 25 climate change hotspots in Asia and Africa found that with reduced male labor in the rural areas, feminization of agriculture was common. But crucially, it was not always accompanied by an increase in women's agency. Agricultural decision-making continued to be in men's hands, with women remaining as farm workers, or, at best, supervisors (Rao et al. 2019).

3. WHAT DO WE KNOW ABOUT GENDER DIFFERENCES IN ADOPTING CLIMATE-SMART AGRICULTURE (CSA) PRACTICES AND TECHNOLOGIES?

There are important gender differences in the ability of smallholder farmers to successfully adapt to climate change due to well-known gender gaps in access to and agency over land, labor, financial and physical capital and information. Identifying how these constraints affect the adoption of CSA technologies and practices depends on the magnitude of the gaps and the input requirements of different CSA interventions. Potential CSA benefits—improved yields, income and resilience, along with lower emissions—apply broadly. But the capabilities and investments they require can vary considerably. Table 2 illustrates this by presenting a number of CSA practices under crop, agroforestry, and livestock/pastoral production systems, along with the initial investment and recurrent seasonal (maintenance) costs of these practices.

Table 2: Initial investment and maintenance costs for select CSA practices ($USD per hectare)

Type of Production Activity	CSA Practice (Country)	Initial investment				Maintenance Cost
		Labor	Equipment	Ag. inputs	Total	Total
Crop	Seed priming and micro-fertilization (Mali	0	0	0	0	3
	Precision conservation agriculture (Zimbabwe)	0	0	0	0	184
	Small-scale conservation tillage (Kenya)	0	0	0	0	93
	Large-scale conservation tillage (Kenya)	0	280	0	208	105
	Tassa planting pits (Niger)	150	5	5	160	32.5
	Runoff and Floodwater farming (Ethiopia)	253	24	106	383	81.4
	Grassfed Fanyu Juu Terraces (Kenya)	270	20	90	380	30
	Shelterbelts agoforestry (Togo)	200	86	90	376	162
	Grevillea agroforestry system (Kenya)	25	10	125	160	90
	Farmer managed natural regeneration agroforestry (Niger)	6	0	0	6	4
Livestock	Night corralling (Niger)	0	15	0	15	8
	Rotational fertilization (Niger)	150	200	0	350	15
	Grazing land improvement (Ethiopia)	320	22	710	1054	126
	Smallstock manure production (Togo)	200	182	0	382	150

Note: Shading of select cells in this table have been added by the authors to emphasize CSA initial investments that are: 1) in excess of $100/ha; and 2) tend to be highly site-specific in the sense that once made, these investments cannot be easily re-assigned other land.

Source: Monchuk and Boudreaux (2015).

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3.1 Women's lack of land tenure rights inhibit adoption

As a general principle, farmers are less likely to make investments in their land if they do not have secure property rights. The gender gap in land rights may therefore be a contributing factor to women's lower adoption rates of CSA practices that require substantial permanent investments. Policies to strengthen women's land rights may provide incentives for greater uptake of these adaptive practices.

Table 2 shows CSA practices that require significant initial investment often are tied to the land itself. Unlike investments in physical capital like machinery that can be easily moved from one location to another, investments in many CSA practices require technologies that are not transportable. They can include things such as constructing planting pits, water diversion ditches, and land terraces; planting improved grasses and fodder and fruit trees; and building fences to improve grazing land and support livestock production. A farmer's decision to adopt a particular practice and undertake the necessary investments is directly linked to the potential stream of benefits that may result, which is heavily determined by the nature and security of a farmer's land tenure and resource rights (Monchuk and Boudreaux 2015).

Women's relative lack of land tenure security is a longstanding constraint to investments focused on improving agricultural productivity, and that extends to CSA interventions. In Ethiopia, for example, access to land is one of the most significant factors determining the adoption of conservation agricultural practices and small-scale irrigation schemes. Yet customary land law in Ethiopia limits women's land use and inheritance rights (Tsige et al. 2020). In Malawi, temperature shocks were found to have a negative impact on consumption only for households in districts that embraced patrilineal customs, where women land managers lost access to land upon the death of their spouse. (Asfaw & Maggio 2018). Female farmers in these patrilineal communities were also significantly less likely to adopt legume intercropping, hybrid seeds and soil and water conservation systems, relative to women land managers in communities that followed matrilineal customs (ibid.).

Conversely, programs that have strengthened women's land rights have had positive impacts on CSA technology adoption. In Rwanda, for example, land registration program participants were twice as likely to invest in or maintain bunds, terraces and check dams for soil conservation. Female headed households whose lands were regularized were the most likely to undertake such long-term investments (Ali et al. 2014). In Ethiopia, Deininger et al. (2008a, 2008b) found a strong positive impact from first-stage land certification on land-related investments, especially terracing and bunding, for both male and female headed households.

3.2 CSA practices can contribute to women's time poverty

Women's preferences for specific climate-adaptive technologies are likely to differ from men's. For women, their lack of access to capital can lead to a preference for relatively labor-intensive practices, contributing to what is sometimes referred to as "time poverty" (Mishra and Pede 2017). Comparative research of climate adaptation strategies in Bangladesh, Ghana and Uganda found that when new technologies and practices are adopted, the more labor-intensive tasks, such as composting and vermiculture, fall to women (Jost et al. 2016). Another study looking at small-scale irrigation in Ethiopia, Ghana and Tanzania found that women tend to adopt labor-intensive irrigation methods while men use mechanized irrigation technologies (Theis et al. 2018).

However, some CSA interventions may have both labor-saving as well as yield-improving potential. In Nepal, an assessment of local crop, climate and social conditions—along with gender divisions in farm labor—identified multiple CSA interventions that could reduce women's drudgery while boosting productivity and farm income (Khatri-Chhetri et al. 2019). They included direct-seeded rice, green manuring, laser land leveling, and rice intensification. Importantly, the prioritization exercise undertaken in this study was highly participatory: female and male farmers developed a list of agricultural and related activities where women's involvement is high. They highlighted key CSA interventions suitable for each activity along with their expected impacts on labor, income and yield. This kind of participatory approach shows the importance of supporting women as co-creators of CSA interventions. It's one way to achieve a more gender-balanced approach to pursuing the science, innovation and entrepreneurship required to help farmers adapt to climate change.

3.3 Access to and use of climate information varies by gender

Climate information, an integral feature of Climate Smart Agriculture, helps farmers improve their adaptive capacities by allowing them to anticipate and strategically plan for climate risks. While there is evidence of substantial benefits of climate information systems (CIS), gender gaps in literacy and mobile phone ownership may limit female farmers' access to and use of CIS.

In the Upper West Region of Ghana, seasonal forecast information through mobile phone technologies was made available to farmers as part of a pilot project conducted by the CGIAR's Research Program on Climate Change, Agriculture and Food Security (CCAFS). A recent study found that while men and women had similar perceptions and awareness of climate change, male farmers were significantly more likely to use the CIS service (Partey et al. 2018). The key determinant of this gender difference was mobile phone access. Low levels of education among women also limited their ability to read and understand the text messages containing climate insights. These findings argue in favor of exploring alternative dissemination channels, such as radio, and the use of local languages to convey climate information.

Box 3

Using data on the gender division of labor to design and deliver climate information for women and men in Senegal

An intervention in Kaffrine, Senegal used participatory action research methods to compare female and male farmers' needs and preferences for information on droughts and rain cessation. The difference in information needs was influenced by women's tendency to plant later in the season. Local social norms dictate that women work on men's plots before their own and wait to use men's farming equipment. These findings were used to develop guidelines for providing more salient climate information to women. The guidelines were then adopted by Senegal's National Meteorological Service to develop targeted early warning advisories and hazard surveillance measures in Kaffrine.

Source: Tall et al. (2014a & 2014b)

4. PROMISING APPROACHES TO GENDER INTEGRATION OF CLIMATE SMART AGRICULTURE

Given the rapid acceleration of climate change and the fast pace of technological innovation, how can women play a greater role in building resilient food systems while benefiting from new interventions? How can women be empowered to lead the development of climate-resilient agricultural systems and food systems? Many local, national and international organizations are exploring new options for effectively integrating gender into climate-smart agriculture programs and initiatives with the goals of both improving adaptation outcomes and gender equality. Several examples include:

- Farm Radio International, Farm Radio Trust and CCAFS interviewed over 1,280 male and female farmers and pastoralists to assess the potential for interactive radio to deliver climate services in Tanzania and Malawi. Women and men differed in time spent listening to the radio. There were also differences in mobile phone ownership and purchases of mobile phone airtime. In response, Farm Radio International and Farm Radio Trust worked with key institutions and radio station partners to develop interactive programming for rural climate services as part of their implementation of the GFCS Adaptation Programme in Africa (Hampson et al. 2015).
- The FAO-Thiaroye fish processing technique was developed in 2008 and is widely used in Côte d'Ivoire, Ghana, Senegal, Togo and the United Republic of Tanzania. It uses an energy-efficient smoking kiln to process fish. It produces superior, safer products and cuts post-harvest losses by up to 50 percent compared to natural drying. Less charcoal is consumed, and the use of biomass (i.e. plant and organic residues and manure) is optimized, lowering greenhouse gas emissions. Since women make up the majority of laborers smoking and drying fish, this technology also lessens their workload while increasing income (Mindjimba et al. 2019).
- IFAD's Adaptation to Climate Change project in Vietnam found multiple benefits from investments in irrigation technologies that shorten the time women spend irrigating their fields from half a day to 15 minutes. Women report that the use of bio-organic fertilizer also helped them save time and reduces the labor burden experienced during crop harvests (Sriram 2018).
- The Mitigation of Climate Change in Agriculture (MICCA) project in Kenya used a gender-sensitive farmer-to-farmer extension approach to improve animal breeds and their productivity and promote sustainable livestock practices. It targeted both female and male farmers. The project found that 97 percent farmers adopting CSA practices reported benefits, such as increased farm income from dairy sales. Women used the increased capital to reduce risks and obtain previously inaccessible credit, enabling them to make further investments in their agricultural enterprises (Mutoko et al. 2015).
- USAID's Yaajeende conservation agriculture program worked with communities in Senegal to allocate degraded and abandoned land to vulnerable women. The women received training in conservation agriculture along with extension services to help them return the land to a productive state. (Kozolup et al. 2013). After applying CSA approaches for a few seasons, the productive capacity of soil improved enough to support the cultivation of more valuable crops.
- The CCAFS project "Climate services for agriculture: Empowering farmers to manage risk and adapt to a changing climate in Rwanda" utilizes baseline research on men's and women's asset control and access to communication channels. These insights inform the design of ICT or media-based communication tools that enable farmers to access climate information (Nsengiyumvaet al. 2018). One of the communication channels involves interactive radio programs, where listeners have the opportunity to call in with requests for additional explanations of the climate information presented.

Several toolkits and learning resources have also been developed to help practitioners design, execute, monitor and evaluate interventions. Tables 3 and 4 provide a curated inventory of some of these resources.

Table 3: Gender, Agriculture and Climate Change Toolkits

UNFCCC's Guidelines for integrating gender considerations into climate change related activities	This technical paper from the UNFCCC aims to provide an overview of existing methodologies and tools for the integration of gender considerations into climate change related activities.
Gender in climate-smart agriculture: module 18 for Gender in Agriculture Sourcebook	This World Bank module provides guidance and a comprehensive menu of practical tools for integrating gender in the planning, design, implementation, and evaluation of projects and investments in CSA.
How to integrate gender issues in climate-smart agriculture projects	This FAO training module provides technical recommendations to address gender issues in the development and execution of CSA-related projects.
CCAFS Gender and Inclusion Toolbox	This toolbox is specifically formulated to tie research outputs to development outcomes, and design tools in collaboration with development partners from the very beginning of interventions.
Agri-Gender Statistics Toolkit	This FAO toolkit is useful for gender sensitive data collection, especially at the intra household level, because it looks at sub-plots within agricultural households.

Table 4: Learning Resources on Gender, Agriculture and Climate Change

Online Course: Gender in Climate-Smart Agriculture Projects (Self-Paced)	This course from the World Bank provides a practical overview, from an operational perspective, of the core principles, elements and enabling environment for integrating gender into climate smart agriculture, as well as showcasing relevant tools and examples related to gender, climate change and agriculture.
Online Course: Gender in Food and Nutrition Security	This FAO course provides concrete skills and tools that can be used in real-life policy and programming situations to integrate gender in a range of food and nutrition programs.
Resource Kit: WEDO Gender and Climate Change Resource Kit	A comprehensive resource kit from UNFPA and WEDO on how gender equality can reduce vulnerability to climate change impacts and how women are uniquely positioned to help curb the harmful consequences of a changing climate.
Practitioner Brief: A Gender-responsive Approach to Climate-Smart Agriculture: Evidence and guidance for practitioners	This CCAFS brief explains how practitioners can take into account the gender gap in agriculture in the development of site-specific CSA-sensitive practices through the adoption of a gender-responsive approach.

5. RECOMMENDATIONS

This brief, while far from comprehensive, points to several high-level recommendations for integrating gender considerations into agricultural development initiatives targeting climate change adaption. It demonstrates the need to build a better evidence base on effective CSA interventions that work for both women and men farmers and how they should be modified to account for existing gender inequalities.

For AgDev programming, building some of the following components into portfolio investments can contribute to a more gender intentional approach to climate change adaptation:

- Conducting field-based gender assessments of the division of labor across crops and activities can inform the development and diffusion CSA interventions that are relevant for both women and men farmers. Cross-reference these insights with climate risks associated with particular crops and farm activities.
- Research and development initiatives, particularly in the areas of crop improvement, seed systems, and livestock, can identify and prioritize CSA technologies that target crops and livestock often raised by women and activities that can reduce their labor burden.
- New approaches for identifying "hotspots" where women farmers and agriculture workers are especially vulnerable to climate change can be used to target climate adaptation investments to specific geographic areas.
- Investment in and advocacy for efforts to give women greater land rights can address a significant gender barrier to the adoption of many CSA technologies and practices. This work can also be gender transformative insofar as land rights are the key to multiple aspects of empowering rural women.
- For the Digital Farmer Services (DFS) portfolio in particular, research to inform the development and dissemination of climate information to ensure it's equally accessible to women and men farmers would be an important contribution to integrating gender considerations into DFS platforms.
- With respect to building the evidence base, the foundation could play a leadership role by investing in high quality (experimental or quasi-experimental) research in the following areas:
  - Identifying and quantifying the gender-differentiated impacts of climate change in agriculture.
  - Identifying and measuring gender barriers to adopting CSA practices and technologies and considering incentives and opportunities for more gender intentional approaches to CSA innovations.
  - Rigorously assessing the impact of innovative gender-intentional CSA initiatives on agricultural productivity, livelihoods, climate resilience, women's empowerment and gender equality.

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